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In India.

CONDUCTED BY

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THE

Calcutta Journal

OF

NATURAL HISTORY.

Contributions towards a Flora of Ceylon. By GEORGE GARDNER, F.L.S., *Superintendent of the Royal Botanic Gardens, Kandy.*

DYSODIDENDRON, *Genus novum.*

(ORD. NAT. RUBIACEÆ, TRIB. ANTHOSPERMEÆ.)

CHAR. GEN.—*Calyx* tubo obovato, cum ovario connato, limbo supero, quadrifido vel rarius quinquefido, lobis brevibus. *Corolla* supera, infundibuliformis, tubo basi intus vel ad faucem hirsuto, limbo 4-5 lobo, lobis æstivatione induplicatis, integris. *Stamina* 4-5, corollæ fauci inserta: *filamenta* brevissima vel subnulla: *antheræ* oblongæ, inclusæ. *Ovarium* inferum, biloculare: *Ovula* in loculis solitaria, erecta. *Stylus* filiformis, inclusus: *Stigma* bifidum, lobis oblongis, obtusis. *Bacca* obovata, calycis limbo coronata, 1-2 pyrena: *Nucleæ* crustaceæ, 1-loculares, 1-spermæ. *Semina* erecta: *Testa* membranacea. *Embryo* in axi albuminis dense carnosi orthotropus: *Cotyledonibus* foliaceis: *Radicula* elongata, infera. Frutices *in India orientali crescentes;* ramis *dichotomis, teretibus;*

foliis *breve petiolatis, ovatis vel ovali-lanceolatis, acuminatis, penniveniis tritis fœtentibus;* stipulis *parvis cuspidatis;* pedunculis *axillaribus terminalibusque, paucifloris;* floribus *albis.*

OBSER.—Notwithstanding that the styles of the three species which form this genus are not so deeply cleft, nor the filaments so long, as they usually are in the tribe *Anthospermeæ,* I believe that I am correct in referring it to that group; the mass of its affinities otherwise being with the genus *Coprosma.* The name is derived from δυσωδία stink, and δένδρον a tree, from the very fœtid nature of the plant.

1. DYSODIDENDRON CEYLANICUM, *Gardn.*

DESCR.—Fruticosa dichotomo-ramosa, glaberrima, foliis breve petiolatis ovali-oblongis basi cuneato-attenuatis vel subobtusis, apice acuminatis, stipulis parvis, triangularibus, cuspidatis, deciduis, pedunculis axillaribus terminalibusque 1-3 floris, basim versus bracteatis, pedicellis pedunculo brevioribus basi apiceque bibracteatis, floribus 4-meris, corolla infundibuliformis extus minuta pubescentiá, fauce hirsutâ.

HAB.—Common in forests in the Central Province of Ceylon, at an elevation of about 3,000 feet. In flower nearly all the year.

DESCR.—A *shrub* 8-12 feet high, highly fœtid in all its parts. *Branches* round. *Leaves* thin, green above, pallid beneath, 3-5 inches long, 1½-2 inches broad, pennivenous, veins prominent beneath. *Peduncle* about six lines long, when three-flowered, the middle flower is sissile. *Calyx: tube* obovate, glabrous, adherent, bibracteate at the base: *limb* 4-toothed, teeth broad, acute, winged about the middle of their margins with a thinner membrane. *Stamens* 4, included: *Ovary* 2-celled, with a single erect ovule in each cell. *Style* filiform, pubescent, included: *Stigma* deeply two-lobed, lobes oblong, obtuse. *Fruit* an obovate, blue, fleshy berry, 4-6 lines long, crowned with the small persistent teeth of the calyx, containing 1-2-pyrenæ: *Nucleæ*

crustaceous, one-celled, one-seeded. *Seeds* erect: *Testa* membranaceous. *Embryo* in the centre of a hard fleshy albumen, orthotropous: *Cotyledons* foliaceous: *Radical* inferior, terete, about twice as long as the cotyledons.

2. DYSODIDENDRON WIGHTII, *Gardn.*

DESCR.—Fruticosa, dichotomo-ramosa, glaberrima, foliis petiolatis ovato-vel oblongo-lanceolatis, acutis vel longe acuminatis, basi acutis, stipulis parvis, triangularibus, cuspidatis, deciduis, pedunculis axillaribus terminalibusque 1-floris, basim versus bracteolatis, pedicellis pedunculo brevioribus basi bracteolatis, apice nudis, floribus 4-meris. Corolla infundibuliformis extus puberula, fauce nudâ, tubo basi intus pilosiusculo.

LASIANTHUS ?—*Fœtens, Wight in Cal. Jour. Nat. Hist. Vol.* VI. p. 517.

HAB.—Common in woods about the Avalanche, Neelgherries. *Wight and Gardner.* Shevagherry hills, Peninsula of India, *Wight.* Flowers in August.

DESCR.—*A shrub* 8-12 feet high, fœtid in all its parts. *Branches* round. *Leaves* 3-3½ inches long, 10-15 lines broad, pennivenous, veins prominent beneath. *Peduncle* about 4 lines long, bibracteate a little above the base and at the apex. *Calyx: tube* obovate, adherent, glabrous, ebracteate at the base: *limb* 4-toothed, teeth broad, acute. *Corolla,* white? infundibuliform, about 6 lines long: *limb* deeply 4-cleft, lobes obtuse. *Stamens* 4, included. *Ovary* 2-celled, with a single erect ovule in each cell. *Style* filiform, puberulous, included: *Stigma* 2-lobed, lobes obtuse. *Fruit* " succulent, baccate, obovate, 2-seeded," according to Wight.

OBSER.—The Specimens from the Shevagherries agree with those from the Neelgherries in every thing except the leaves, which are not so much accuminated.

3. DYSODIDENDRON GLOMERATUM, *Gardn.*

DESCR.—Fruticosa, dichotomo-ramosa, glaberrima, foliis subsessilibus, ovatis vel elliptico-oblongis, basi rotundatis, apice acuminatis api-

culatis, stipulis lati ovatis, cuspidatis, deciduis, pedunculis brevissimis terminalibus, floribus aggregatis, sessilibus, basi bracteatis, 4-5-meris, corolla infundibuliformis minuta puberula fauce hirsutâ.

Hab.—Shevagherry hills, Peninsula of India. *Wight.*

Descr.—*Branches* round. *Leaves* 3-4½ inches long, 1-2 inches broad, pennivenous, veins prominent beneath. *Calyx* 4-5-toothed, teeth ovate, acuminate. *Corolla* infundibuliform, about 3 lines long: *limb* 4-5-cleft, lobes obtuse. *Stamens* 4-5-faucial: *Filaments* short, complanate: *Anthers* included. *Ovary* 2-celled, with a single erect ovule in each cell. *Style* short, included: *Stigma* 2-lobed, lobes flattened obtuse.

Obser.—The specimens which I possess of this species, and which I owe to the kindness of Dr. Wight, are far from being in a good state for describing. There can be no doubt, however, that it belongs to this genus, and is very distinct in many respects from the other two species.

LEUCOCODON, *Genus novum.*

(Ord. Nat. Rubiaceæ, Trib. Gardenieæ.)

Char. Gen.—*Flores* in apice pedunculi dilatati aggregati, sessiles, involucro magno campanulato cincti, squamis concreti. *Calyx: tubo* obovato, compresso, cum ovario connato: *limbi* superi subintegerrimi. *Corolla* supera, infundibuliformis, fauce nuda: *limbi*, 5-partiti, lobis planis, patentis, oblongo-lanceolatis. *Stamina* 5: *Filamenta* subnulla: *Antheræ* oblongæ, subexsertæ. *Ovarium* inferum, biloculare, disco epigyno depresso: *Ovula* plurima, in placentis bilobis dissepimenti utrinque affixis, anatropa. *Stylus* simplex, exsertus: *Stigma* conicum, bipartitum, laciniis oblongis, obtusis. Fructus baccatus, carnosus, 2-locularis, indehiscens. *Semina* plurima, subrhomboidea, compressa. *Embryo* intra albumen carnosum

orthotropus : *Cotyledonibus* oblongis, obtusis : *Radicula* tereti, obtusa, umbilico proxima. Frutex *Ceylanicus, scandens, radicans :* foliis *oblongo-lanceolatis, utrinque acutis :* stipulis *magnis, interpetiolaribus, basi connatis, apice bidentatis, deciduis :* capitulis *terminalibus, breve pedunculatis, multifloris, involucratis :* involucro *squamis concreto :* floribus *albidis.*

1.—LEUCOCODON *reticulatum, Gardn.*

HAB.—On trees in dense virgin forests in the Ambegamoa district, Ceylon, at an elevation of about 4,000 feet. Flowers in January.

DESCR.—*Stem* scandent, radicant, round, very much branched above. *Branches* round, glabrous, leafy. *Leaves* opposite, petiolate, oblong-lanceolate, acute at the base, acute or subaccuminate at the apex, glabrous, veins prominent beneath, intervenium reticulated, dark green above, pale beneath, 3-4½ inches long, 18-20 lines broad. *Petiole* 6-8 lines long. *Stipules* interpetiolar, oblong, bidentate at the apex, connate for about a third of their length at the base, the connate portion densely covered with ferruginous hairs internally, 12 lines long by 4 broad, of a thin membraneous texture, and of a pale green color, deciduous. *Flowers* terminal, capitate, involucrate. *Involucrum* subtended by two bracts similar to the stipules, broadly campanulate, about one inch deep, and about 1½ wide, 8-costate, 8-dentate, teeth broadly ovate, acute, the whole of a greenish white color. *Receptacle* plain. *Calyx : tube* obovate, adhering to the ovary, compressed : *limb* broadly and shortly tubular, margins subentire, the whole of a whitish color, and about 3½ lines long. *Corolla* superior, greenish white, about 8 lines long, infundibuliform, glabrous, 5-parted, lobes oblong-lanceolate, acute. *Stamens* 5 : *Filaments* none : *Anthers* sessile in the throat of the corolla, sub-exserted, oblong, attached by the base, 2-celled, introrse, dehiscing longitudinally. *Ovary* inferior, 2-celled, with numerous round compressed ovules attached to placentæ, which protrude from the middle of the dissepiment, crowned by an annular fleshy disk. *Style* filiform, exserted : *Stigma* thick, conical, 2-lobed, lobes oblong, obtuse. *Berry* obovate, compressed, 4-5-angled, white, fleshy, crowned by the persistent tube of

the calyx, 2-celled. *Seeds* numerous, erect, attached to fleshy placentæ, which adhere to the dissepiment, subrhomboid, compressed: *Testa* crustaceous, black in the middle, with light brownish margins, slightly pitted. *Embryo* in the centre of fleshy albumen: *Radical* next the hilum, obtuse, about as long, and as broad as the compressed obtuse cotyledons.

Obser.—This remarkable Rubiaceous genus, evidently belongs to the tribe *Gardenieæ*, and to Decandolle's first subtribe, *Sarcocephaleæ*, but to none of the few genera which have been referred there, does it approach very closely. From *Canephora* it is distinguished by the concrete, not free scales of the involucre, the nearly entire limb of the calyx, and by its many seeded fruit. From *Breonia* it likewise differs in the nature of the involucre, and particularly so, in that of the placentæ. The name is derived from λευκος white, and κωδων a bell, from the white campanulate involucre.

CARRIA, *Genus novum.*

(Ord. Nat. Ternstromiaceæ, Trib. Gordonieæ.)

Char. Gen.—*Calyx* persistens, decidue bracteolatus, 3-5-sepalus, sepalis rotundis, concavis, profunde emarginatis, subæqualibus. *Corollæ* petala 5, hypogyna, sepalis alterna, ima basi coherentia, late obovata, emarginata, æstivatione imbricata. *Stamina* plurima, hypogyna, pluriseriata, petalorum basibus adhærentia: *Filamenta*, filiformia, valida, inferne in fasciculos quinque subcoalita: *Antheræ* extrorsæ, ovatæ, basi affixæ, erectæ, biloculares, connectivo lato carnoso, loculis disjunctis, longitudinaliter dehiscentibus. *Ovarium* liberum, 5-loculare: *Ovula* in loculis 4-6, angulo centrali biseriatim inserta, pendula. *Stylus* simplex: *Stigma* quinquefidum. *Capsula* oblonga, pentagona, 5-locularis, loculicide 5-valvis, valvis lignosis. *Semina* in loculis 3-5, ovata, subcompressa, biseriatim pendula, imbricata, superne in alam membrana-

ceam, oblongam, producta. *Embryo* exalbaminosus, rectus : *Cotyledonibus* ovatis, plano-convexis : *Radicula,* elongata, obtusa, supera. Arbor *Ceylanica, procera:* foliis *alternis, subsessilibus, ellipticis, coriaceis, integerrimis, retusis, margine revolutis:* stipulis *nullis:* floribus *axillaribus terminalibusque, solitariis, magnis,* coccineis.

1. Carria.—*Speciosa, Gardn.*

Hab.—Gregarious in a rather moist part of the forest above Rambodde, Ceylon, at an elevation of about 4,000 feet. Flowers from May till September.

Descr.—A tree 40-50 feet high. *Branches* round, glabrous, the younger ones only leafy. *Leaves* subsessile, alternate, elliptical, obtuse at both extremities, retuse and apiculate at the apex, margins entire, very much revolute, glabrous, coriaceous, veinless, green and shining above, somewhat glaucous beneath, 3-4½ inches long, 1½-2 inches broad. *Stipules* none. *Flowers* large, solitary, axillary and terminal. *Pedicel* very short, bearing a few small bracts. *Calyx* free, persistent: *Sepals* 3-5, rotund, concave, deeply emarginate, about 8 lines long by 10 broad, of a coriaceous texture, and with scarious ciliated margins. *Corolla* broadly campanulate, of a dark crimson color: *Petals* 5, hypogynous, broadly obovate, emarginate, cohering together at the base, where they are a little tomentose externally, æstivation imbricate. *Stamens* numerous, in several series hypogynous, adhering to the base of the petals, and about half their length: *Filaments* filiform, stout, combined at the base into five fascicles: *Anthers* ovate, 2-celled, the cells separated by a broad fleshy connective, bursting longitudinally, externally. *Ovary* superior, 5-celled, with 4-6-ovules in each cell, attached to the inner angle in a double series, pendulous. *Style* about as long as the stamens, stout, clavate, somewhat 5-angled: *Stigma* 5-lobed. *Capsule* oblong, 5-angled, angles rounded, 5-celled, 5-valved, valves woody, dehiscence loculicidal. *Seeds* 3-5 in each cell, ovate, compressed, pendulous, imbricated, in two series: *Testa* membraneous. *Embryo* exalbuminous, straight: *Cotyledons* ovate, obtuse, plain: *Radical* shorter than the cotyledons, cylindrical, obtuse, superior.

Obser. I.—This, which is perhaps the most beautiful forest tree in Ceylon, I have much pleasure in dedicating to the Honorable W. O. Carr, F.L.S., Senior Puisne Judge in Ceylon, a gentleman who takes a lively interest in all that relates to Horticulture, and to whom I am much indebted for the facilities which he has afforded me for the investigation of the Botany of the island.

Obser. II.—The nearest affinity of this new genus is with *Gordonia*, from which it is readily distinguished by its extrorse anthers, and its plain, not plicate, cotyledons. *Pyrenaria* of Blume, and *Godoya* of Ruiz and Pavan, agree with it in having extrorse anthers, but both are otherwise very distinct.

Kandy, Ceylon; February 8th, 1846.

Description of a new species of Anemia *from the Neelgherry Mountains. By* George Gardner, F.L.S., *Superintendent of the Royal Botanical Gardens, Ceylon.*

In proportion as our knowledge of species of plants increase, enquiries into the laws which regulate their dispersion over the earth's surface become surrounded with greater difficulties. Until lately, Botanists were satisfied with the bare statement of such facts as,—all *Cacti* are confined to the continent of America,—no true *Heaths* are to be found in America,—no *Roses* exist in the Southern hemisphere, &c. Orders and genera, however, which were considered to be peculiar to particular countries have been found to possess a much wider range, than was supposed. The genus *Anemia* is a remarkable instance of that fact. Sprengel, who has given the latest systematic description of the species belonging to it, enumerates 27, some of which, however, when more carefully

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examined and compared will no doubt be reduced; while on the other hand, several new ones have since then been discovered; those found by myself during my travels in South America, amounting to upwards of half a dozen. All these are American, and until about the year 1835, the genus was not known to exist out of that continent. Somewhere about that period Dregi found one in the interior of South Africa, (*A. Dregeana,* Kunze, figured in Hooker's "Icones Plantarum," at tab. 236), and besides the one now about to be described from the Neelgherry range, a third seems to have been found in the Old World, as I learn from my friend Mr. Heward of London, who in a letter lately received, says: "Your finding an *Anemia* in India, is highly interesting. It is curious, that a genus for so many years supposed to belong to the New World, should all at once be found at the Cape of Good Hope (A. Dregeana;) in Abyssinia by Schimper (a species so nearly allied to *A. flexuosa,* that I can see no difference;) and by Dr. Wight and yourself in India."

It is true that those lower tribes of plants to which the name of *Cryptogamia* is given, are well known to possess a much wider range, both as regards generic and specific forms, than those which are of a more complex organization, but, even among the latter, some remarkable examples occur of individuals of the same genus, and even identical species, being found in very distant countries, without including those whose habits are littoral. To ascertain the cause why such nearly allied forms are found in such different parts of the world, is a problem of very difficult solution; but so many important facts bearing on this subject, have been established of late years, that we may hope the time will arrive, when, from the united labours of the many enlightened and enthusiastic students of nature who are now in the field in all parts of the world, the science of the Geographical distribution of plants and animals will make a nearer approach to an exact science, than it does at present. Hitherto, temperature, moisture, soil, and elevation, have been considered as the most important

causes which influence the Geographical conditions of both plants and animals, but there is, no doubt, something far beyond them, which still remains to be discovered.

The species of *Anemia*, which I have now to describe, was first found by Dr. Wight in the year 1844; and in the February of the following year, I had the pleasure of accompanying him to the locality where it grows, and obtaining a supply of specimens, during a month of delightful botanizing, which we had together, on the Neelgherry Mountains.

ANEMIA WIGHTIANA, *Gardn.*

Plate I.

A. tota dense ferruginea villosa, fronde sterili oblonga bipinnata, pinnis oppositis ovato-oblongis subsessilibus, pinnulis oppositis sessilibus oblongis obtusis inferioribus lobatis, fertili apice tripartita, partitionibus duabus fertilibus ovato-oblongis laxis tripinnatis, tertia sterili subæqualia ovata bipinnata.

Hab.—In an open, bushy, rocky place, below Sispara, on the Malabar slopes of the Neelgherries, at an elevation of about 5,000 feet. February 1845.

Descr.—Whole plant densely covered with long ferruginous colored villi. *Caudex* creeping. *Fronds* cæspitose. *Stipes* of the *sterile fronds* flattened, sulcate on the upper surface, and from $2\frac{1}{2}$-5 inches long: *frond* 4-5 inches long, oblong, bipinnate: *pinnal* opposite, subsessile, ovate-oblong, 12-15 lines long: *pinnules* opposite, sessile, oblong, obtuse, the lower ones somewhat lobed. *Stipes* of the *fertile frond* 8-10 inches long, semi-terete, sulcate on the upper surface: *fronds* 3, two of which are *fertile* from 5-8 inches long, ovate-oblong, loosely tripinnately paniculate, the third *sterile,* about equal in length with the others, ovate, and in other respects similar to the true sterile fronds. *Sporangia* placed in two series on the back of the lateral veins, sessile, globose, with a very small portion of the apex crowned with brown radiated striæ, the rest of a pale colour, and vascularly reticulated. *Sporales* triangular, glabrous, striated.

This species of Anemia is very closely related to the Brazilian *A. flexuosa,* and on comparing it with a fine suite of specimens of that species, which my Herbarium contains from Brazil, I find that *A. Wightiana* is distinguished from it by being more densely villous all over, by being decidedly bipinnate, and by the rachis of the pinnal being straight, not flexuose. The spikes are, besides, more loosely paniculate than they are in *A. flexuosa.*

DESCRIPTION OF PLATE I.

Fig. 1 and 2, *Anemia Wightiana,* Nat. Size; 3, a pinna; 4, a portion of the fructified part of the fertile frond; 5, sporangium; 6, do. burst; 7, a sporule:—all magnified.

Kandy, 1*st Dec.* 1845.

Notes on Indian Botany. By ROBERT WIGHT, M.D., F.L.S., *Imp. Acad. Nat. Curios. Bonn.*

Some years ago, I published under the name of *Nimmonia,* a plant, which on further acquaintance, I found belonged to an already existing genus, requiring the reduction of my supposed new one. Since then, I have been anxious to meet with another to which I might, appropriately, transfer the name of that much respected person, and preserve in the records of our science, the memory of one, well meriting the distinction, as well for his own labours, as for the able manner in which he assisted in the preparation of, and finally editing, Graham's "Catalogue of the plants growing in Bombay and its vicinity." Such a plant has recently, through the kindness of Mr. Law of the Bombay Civil Service, fallen in my way, and is the more appropriate, as having been partially examined and described by Mr. Nimmo, who indicates the probability of its forming the type of a new genus. The plant I am about to describe, if the same as Mr. Nimmo's, of which I think there can hardly be a doubt, certainly does form the type of a new and most distinct genus, referable to the tribe *Trichilieæ,*

of the order *Meliaceæ*, occupying, in the present series of genera, a place midway between *Nemedra* and *Amoora*.

In 1830, A. de Jussieu established the genus Nemedra for the reception of a New Holland plant, described as having a woody stem, unequally pinnated leaves, the leaflets few pairs, sub-opposite, with axillary and terminal panicles and small flowers: different parts of the plant are, moreover, said to be sprinkled [illegible] h furfuraceous scales. The character of the genus [illegible] bed. Petals 5. Filaments 8-10, united into a [illegible] urceolate tube, thickened at the base, forming 8-10, prominent. Costæ bearing the enclosed, erect pyramidal anthers, (as if sitting on chairs, whence the name). Stigma sessile, ovoid, 3-lobed. Ovary 3-celled with a single ascending ovule in each. Fruit unknown.

Some months ago, I received from Mr. Law, along with many others, a single specimen of a plant labelled, "*Meliacea*, appears to be the type of a new genus. Staminal tube globose, with a very small aperture. Probably *Epicharus exarillata* of Graham's Catalogue."

On examining this plant, rather hurriedly at that time, I made the following memorandum of its generic characters. "Calyx minute scutelliform, slightly 4-lobed or toothed. Petals 4, oval, very obtuse, imbricating in æstivation. Staminal tube ovoid, orifice very small, entire, not costate within: anthers eight, included, attached by the back near the middle of the tube, oblong. Ovary 3-celled with one ovule in each: ovules attached, near the bottom of the cell ascending: stigma sessile, 3-lobed. Fruit ?—Probably *Nemedra*, but differs in the quaternary proportion of its flowers and the form and mode of attachment of its anthers."

At the time of making the above note, it seems to have occurred to me, that by slightly modifying the character, this plant might be admitted as a new species into the genus *Nemedra*, and accordingly so named my specimen. A more careful consideration of the characters of the two plants has led to the conviction, that they cannot be associated in the

same genus, so long, at least, as the fruit of both remains unknown; and even supposing they corresponded in that point, still there are distinctions enough in the flowers, to separate them. Under the belief then, that this is a new and most distinct genus, I have great pleasure in dedicating it to its presumed discoverer. Its place in the natural system, is exactly intermediate between *Nemedra* and *Amoora*, the former having *quinary*, the latter *ternary* flowers, while this has them *quarternary*; they all agree in having a 3-celled ovary, but *Nemedra* and *Nimmonia* has solitary ovules, *Amoora* two in each cell.

NIMMONIA, *R. W.*

N. O. Meliaceæ.

GEN. CHAR.—Calyx gamosepalous, 4-toothed. Petals 4, æstivation imbricative. Staminal tube ovoid, entire or slightly crenated on the margin, orifice contracted: anthers 8, oblong, included, attached by the back to the middle of the tube. Ovary 3-celled, with one ascending ovule, attached near the bottom, in each: stigma 3-lobed, sessile. Fruit?

Arboreous? leaves unequally pinnate, leaflets about five alternate, oblong elliptic, entire, obtuse or shortly accuminate, penninerved, glabrous. Inflorescence, racemosely panicled, axillary: flowers numerous, short pedicelled, small white (?) peduncles and calyx shortly hairy. Petals three or four times longer than calyx, very obtuse, about the length of the tube. Staminal tube ovoid, orbicular above, with a small circular aperture, nearly the length of the petals: anthers 2-celled, attached by the middle of the back. Ovary, in the dried specimen, triangular, hairy, surmounted by a sessile 3-lobed stigma.

N. LAWII (R. W.) *Epicharis exarillata?* Nimmo, Bombay Catalogue, No. 227, p. 31.

HAB.—Bombay, J. S. Law, Esq. Exact station not mentioned.

The following brief description of Mr. Nimmo's plant, I extract from the Bombay Catalogue.

"EPICHARIS EXARILLATA, N. *Boorumb.* A tree, leaves pinnate, leaflets two or three pairs; flowers in December and January; small, white, in axillary racemes: they rarely expand, and are generally destroyed by insects. Fruit, size of a plum, pear-shaped, indehiscent, abounding in a white, resinous juice. This tree requires examination; probably it will turn out the type of a new genus. Kandallah hills about Nagatnah, the Parr Ghaut, &c.

This description, though brief and imperfect, seems, so far as it goes, sufficiently applicable to the specimen before me; especially when taken in conjunction with the character of the order to which it is referred. The numerous stations mentioned in the Catalogue, strengthens the supposition of their identity.

I have felt it necessary to give a new specific name, even though almost certain, that the two names refer to the same plant; as in that case, the want of an arillus will, in all probability, form an important part of the generic character, and then becomes inapplicable as a specific designation.

LAWIA, *R. W.*

N. O. Rubiaceæ, § Hamelieæ.

GEN. CHAR.—Calyx: limb 5-6-parted. Corolla tubular gibbous at the apex, limb 5-6-cleft. Stamens 5-6-attached to the very base of the corolla; filaments very short. Ovary 5-6-celled: ovules numerous, covering the placenta on all sides. Placentæ free, attached by a short pedicel to the inner angle of the cell. Style short: stigma 5-6-lobed. Seeds numerous, small, black, irregular. (Somewhat resembling grains of gunpowder.)

Herbaceous plants, puberulous all over. Leaves longish, petioled oblong-oval, acuminate at both ends, membranaceous; transversely parallel veined; deep green above, glaucous

beneath. Stipules triangular, acute, cymus terminal twice or thrice trichotomous, lax, each division embraced by two connate membranaceous bracts. Flowers pedicelled, small, yellow. Calyx: tube short, campanulate, deeply cleft into 5 or 6 narrow, somewhat subulate divisions, corolla tubular, about the length of the calyx, somewhat ventricose at the throat: limb 5-6-cleft, tube slightly hairy within. Stamens very short, apparently scarcely attached to the corolla, but springing directly from the disk. Style short: stigma large 5-6-lobed, lobes acute.

LAWIA ACUMINATA, (R. W. Icones, No. 1070; unpublished.)

HAB.—Courtallum and western slopes of the Shevagherry mountains, in dense jungles, flowering and bearing ripe fruit in August and September.

This genus which is clearly referable to the tribe *Hameliеæ* of *Rubiaceæ*, is, so far as I am aware, the only genus of the Indian flora referable to that tribe, I therefore dedicate it to my valued correspondent J. S. Law, Esq. of the Bombay Civil Service, as an appropriate tribute to one, who stands nearly alone in his order, as an enthusiastic lover of Botany, and who, in the midst of the harassing and fatiguing duties of a collector's office, still finds some leisure to devote to his favourite pursuit.

A short time before the late Mr. Griffith left Calcutta for Malacca, I sent him drawings of two, and specimens of several other species of *Podostemon,* as materials towards a monograph of the Indian species of the order, which he then contemplated undertaking. Among those sent was one from Mr. Law, which we considered the type of a new genus, and which was to have been dedicated to its discoverer. Unfortunately the monograph, so far at least as I have heard, was never written; I therefore took advantage of the opportunity

which this plant presented, while naming a figure of it for my Icones, of placing Mr. Law's name permanently on the records of Botany, by dedicating the genus to him, though, perhaps, less appropriately, than if the plant had been found by himself.

VOGELIA, *Lamark.*

The genus Vogelia, established by Lamark upwards of 50 years ago (1792,) was founded on a very indifferent specimen from the Cape of Good Hope. From that time to the present, the species seems not to have been again discovered by any of the numerous explorers of the flora of that promontory, and his figure and description, still remains the only record of its existence; and, but for the figure given in his illustrations, would, probably, in this time have been supposed a doubtful genus, founded by mistake on some other plant. Under these circumstances, the discovery of a new species in India, cannot but be considered an interesting addition, not merely to our flora, but to the system of plants, as establishing, beyond doubt, the correctness of Lamark's character.

It is now I think about two years since Mr. Law sent me, in a letter, a few flowers, received from Dr. Gibson, of what Dr. G. supposed a new species of *Plumbago,* but which enabled me, with the aid of Lamark's figure, to identify it as a new species of the long lost *Vogelia;* which, in correspondence with Dr. Gibson, I determined, as in the case of the original species, to call after its native country; a figure of which will very shortly appear in my Icones, under the name of *Vogelia Indica,* Lamark's being named *V. Africana.* The genus being new to India, I have thought it well to notice it, (as well as several other novelties in course of publication in that work,) in the Journal, as having a much wider circulation than so costly a work as the Icones can be expected to possess.

When in course of acting on this resolution, I had the gratification of receiving from Mr. J. E. Stokes, of the Bombay

Medical Service, a very promising pupil of Dr. Lindley, lately come to India, additional specimens and a full description of the species. As he knows the plant, while I have only seen specimens, I gladly substitute, with a few verbal alterations, his description of it and some remarks on the genus, for those I had previously prepared, as being on the whole more correct; the specimens from which mine was taken, having been injured by damp in the course of transmission. I have only further to add, that I hope soon to see Mr. Stokes a regular contributor to your pages, and, judging from some of his manuscripts, now before me, we may anticipate many interesting communications from his pen.

VOGELIA INDICA. (W. and G. *V. perfoliata*, Stokes' MS.) leaves ovate, perfoliate, coriaceous, glabrous.

HAB.—Baikur near Deesa and Aboo. Stokes. Humicul ghaut. Gibson.

Shrubby, 6-8 feet high, with weak straggling branches. Stem round, finely striated in the younger parts. Leaves bifarious auricled, and by the union of the auricles perfoliate, very thick and coriaceous, smooth above, below covered with scurf, consisting of lepides, arising from pits in the epidermis. Lower leaves 5 inches long by 3 broad, waved. Calyx tubular and angled at the base, cleft half way down into 5 divisions, segments membranaceous, filmy, with a thick middle vein and transverse ruge (or plaits) on each side, persistent.

Corolla more than twice as long as the calyx, tubular; tube yellowish orange, streaked with red; limb five-cleft; lobes smallish, emarginate, with a minute mucro in the cleft, marcescent. Stamens five, attached to the very base of the corolla, hypogynous; filaments glandulose at the base, as long as the tube, slightly adherent, opposite the lobes.

Ovary angular, 1-celled with a single pendulous ovule; style slender, bearded at the base, as long as the stamens;

stigma 5-lobed. Capsule [5-valved, W.] separating, entire, with the withered corolla, like a cap, leaving exposed the single seed, pendulous from the apex of a long podosperm. The capsule, during this process, splits into five parts at the base, but remains united at the apex by the persistent, hairy base of the style.

The following remarks are Mr. Stokes': "It seems curious that Brown (Prod.) gives 5 styles to Plumbagineæ [Plumbago, however, as defined by him, has 'stylus 1, filiformis' W.] Lindley more positively insists on this character, both in his marks of *Plumbales* and *Plumbaginaceæ*. Endlicher makes his 'Plumbagineæ veræ' to have *one* style; and he notices the curious fact, that the stamens are opposite the lobes of the corolla, which neither Brown nor Lindley mention, and which one would therefore suppose was almost peculiar to *Primulaceæ* and *Myrsinaceæ*, by so much stress being laid on that character in these Orders. It is curious, that in these *three* Orders (not to mention others) two with central placentas, and one with an equivalent basal ovule, the stamens should in all be opposite the petals."

The two species, of which the genus now consists, may be thus very briefly defined.

V. Africana (Lam.), foliis obcordatis.

V. Indica (Gibson), foliis ovato-perfoliatis.

MONSONIA.

I am indebted to Mr. Stokes for specimens, and the following very full description of another genus new to the Indian Flora.

Gen. Char. Monsonia, (Linn. fil. D. C. &c.) Calyx 5-sepaled, sepals equal, aristato-mucronate at the apex. Petals equal, twice the size of the calyx. Stamens 15, monadelphous at the base, partially united above into 5 fascicles of 3 anthers each; carpels 5, indehiscent, 1-seeded, attached to a central column, and ending in very long awns.

M. (Olopetalum) Lawiana (Stokes' MS.) densely clothed with soft lymphatic, glanduliferous pubescence: leaves ovate-cordate, acuminate, dentate; stipules and bracts herbaceous: peduncles axillary, one-flowered, carpels obliquely truncated at the apex, hispid.—The two halves of the leaves in this species, show a tendency to close, like those of Dionea. Is this peculiarity limited to this species, or is it common in the genus?

Geranium Lawianum, Nimmo, in Graham's Catalogue of Bombay Plants, last page.

Hab.—On hilly grounds in the Baikur district N.E. of Deesa. Stokes' MS.

Root fusiform; stem ramous, semi-decumbent, clothed all over with soft glanduliferous pubescence of a pinkish tinge; stipules minute, subulate, deciduous, leaves opposite, one smaller (from whose axil the peduncles and branches spring), cordate, acute, serrated, villous. The two halves of the blade have a tendency to collapse like those of some of the sensitive plants. Peduncles longer than the leaves, one-flowered, axillary, solitary, jointed below the middle, furnished at the joint with two subulate bracts, straight when in flower, afterwards, as the fruit advances, bent acutely downwards at the joint, and equally acutely upwards immediately below the carpels. Flowers rather large for the size of plant, pink. Sepals 5, obovate-cuniate, aristato-mucronate, pubescent, membranaceous and translucent on the margin. Petals five, unguiculate, 3-veined, imbricated in æstivation, limb crumpled, very fugacious. Stamens 15, monadelphous at the base, dividing above into five 3-stamen fascicles, the lateral anthers smaller and folded behind the middle one in æstivation; anthers adnate. Ovary of 5 carpels, attached to a central axis: styles as many, the length of the axis and adhering to it, all softly pubescent when young,

elongating as the seed advances towards maturity, when the whole carpel is about 3½ inches long and covered with stiffish, brown hairs. Fruit of five carpels, separating from the axis by the spiral twisting of the styles. Carpels one-seeded, conical, tapering below and ending in a brown hook; above truncated obliquely outwards and just where the style begins, furnished with two pits, one on each side of a middle ridge, which forms the base of the style, muricated within: styles or aristæ about 3 inches long, fitted to furrows in the gynobase, the inner face covered with long adpressed hairs, which start up when the style is released.

I find in those I have examined, the styles separate at both ends, and, usually, the stigmatic one first. The seed sufficiently accords with Endlicher's descriptions of those of both *Erodium* and *Monsonia*, except that it has not a crustaceous, but membranaceous testa: the embryo, cotyledons, and radicle, all agree with the descriptions of those of *Erodium*, but are not described under *Monsonia*.

It seems curious, that this plant should have been found and named by three different persons, each of whom has given it a different generic name. Mr. Nimmo has placed it among the *Geraniums*: Captain Munro who found it, or one of the same genus, near Agra, has made it an *Erodium*: while Mr. Stokes has, I think, more correctly given it to *Monsonia*.

The following essential characters of the three genera, will enable any one to determine, which of the three has come nearest the truth.

MONSONIA, petals equal, stamens 15.

GERANIUM, petals equal, stamens 10 fertile.

ERODIUM, petals equal or unequal, stamens 10; 5 fertile, 5 sterile; calyx not tubular.

From these it appears, that so far as such brief artificial characters go, it is clearly a *Monsonia*; but I should not wonder to learn, on its being carefully compared with genuine species of the genus, that it presents characters sufficient to keep it

distinct from even it. This comparison I am unable to institute, not having specimens of the Cape genus.

The synonymy of this plant now stands thus,—MONSONIA LAWIANA, Stokes' MS. *Geranium Lawianum,* Nimmo, Bombay Catalogue. *Erodium chumbulense?* Munro, Hort. Agrensis. Wight's Icones, No. 1074. The last name I quote with a doubt, for though there cannot be a doubt of the identity of the genus of the two plants, they may, on comparison, be found specifically distinct. Indeed the differences between the figure and the specimens from Deesa, are sufficient to constitute them distinct species, but on this I do not feel disposed to place implicit reliance, as the differences may be, partly at least, attributable to the artist, and I have not seen specimens to compare the two. I am inclined to look upon them as distinct species, as Munro's figure, in some points, corresponds better with the description of *Monsonia Senegalensis* of Guillemen, a nearly allied species, than *M. Lawiana,* but all three seem to require comparison before satisfactory characters can be obtained. The discovery of this plant in India, adds another link to the chain which already so intimately connects the Floras of India and the west coast of Africa.

Importance of Auscultation and prevalence of Thoracic complaints amongst Natives. By DR. GOODEVE, *Superintendent to the Cawnpore Dispensary ; 31st July,* 1845.

Baboo Ramnarain has alluded to the introduction of auscultation, in investigating disease, since my superintendence of the Dispensary. I may remark, that the great frequency of thoracic complaints among the natives of these districts, renders attention to the condition of the pectoral organs, absolutely necessary, both for accurate diagnosis and for the consequent benefit to the patients. The above-mentioned frequency of pulmonary complaints, has been forced on my notice,

by a large number of post-mortem examinations at the Jail and Dispensary. We make it a rule, therefore, to examine the condition of the chest, in all cases of chronic diarrhœa, dysentery, the so called remittent, but frequently hectic fever, and in continued fevers in the cold season. The patients often make no complaints of chest disease themselves, their attention being concentrated on the symptomatic fevers or diarrhœas, or failure of strength. It is necessary to question them closely, to watch the general symptoms of lung affections, and generally to resort to auscultation, before coming to a conclusion as to their real complaints. Within twelve months, we have met with every form of pulmonary disease, except the malignant ones, and many of the diseases of the heart. Tubercular phthisis, we have had an abundance of, as the detailed autopsies forwarded every month, show.

In the cold season, Pneumonia and Broncho-pneumonia, were prevalent, the patient complained mostly of continued fever; he made light of the little dyspnœa and cough that accompanied his complaint, and as the pleura was not generally involved, there was little or no pain to draw his attention to the chest. We found careful auscultation of great use here in directing the mode of treatment. This consisted in bleeding in the early stage when the patient's strength allowed: calomel carried to ptyalism, if necessary, and large doses of tartar emetic. Some of the patients took 15 or 20 grains of it daily, for two or three days, without any inconvenience whatever. When the complaint had passed into the third stage, or the bronchial tubes were loaded with secretions, of course a stimulating plan was adopted, and carbonate of ammonia was found most useful.

Asthenic-pneumonia, I have frequently met with among the weak and the old; in these cases, diarrhœa, dysentery, or perhaps some form of standing sore, and great prostration, were the principal symptoms: a very careful inspection would show, that there was some dyspnœa from the slight dilatation of the alæ nasi, and some heaving of the chest, the breath had a fœtid smell, but not amounting to that produced by ordinary gangrene; auscultation was here of considerable assistance. In the post-mortem examinations, we found consolidation of parts of the lungle, but the color was darker (sometimes approaching to brown or muddy color,) than the consolidation of asthenic-pneumonia, while

the third stage, or grey softening of the asthenic kind, was replaced by cavities containing mud colored, fœtid serum. The disease was most frequently found in the posterior parts of the lungs, but this was by no means always the case, as I have found both consolidation and cavities near the nipple. When pleurisy is excited in this form, the lymph exuded, is deficient in plasticity, and the adhesions that the lung forms with the parietes, are easily broken down. In these cases, antiphlogistic treatment cannot be thought of, stimulating medicines are alone of use. When the disease is circumscribed, which it seldom is, these means I think I have known to produce great benefit, if time be allowed for them to be followed up by tonic medicines. I have generally found this complaint to arise in the ill-fed and ill-clad. The existence of chest diseases in such numbers, will throw some light on the reason of the mortality which so constantly attends dysentery, &c. in the natives.

Medical Report on the causes of the late Sickness at Akyab, accompanied with Sanatory Observations and Suggestions, in accordance with instructions conveyed in a Letter from the Commissioner of Arracan, No. 105 ; *dated* 4*th June,* 1844.

1. In considering the causes which have operated in producing the late fatal sickness in Akyab, of the first importance is the nature of the disease from which the before-mentioned result arises, whether Endemic or arising from locality, Epidemic or arising from adventitious causes. Disease, when attacking a community generally, belongs to one or both of these classes, distinct, however, as they appear, both as respects origin and individual character. Yet when an Epidemic disease has once made its appearance, its progress is accelerated or impeded, by the same causes which influence the other form. Sanatory suggestions with regard to place, will, therefore, be equally efficacious in both instances ; but as these two divisions of disease have a different origin, the preventive policy will be different ; and this more especially refers to small-pox, which, as I shall hereafter prove, is one of the most fatal Epidemics that ever attacked the people of Arracan. With a view, therefore, of ascertaining the particular form or class of disease which has lately been attacking the people of this

province, I have considered it of the utmost importance, that an accurate deduction should be made, and have, accordingly, prepared a series of Statistical tables, of all registered patients, or otherwise, in Akyab; certain data can then be easily formed for the amelioration of the pestilence, with an almost certainty of success. In preparing these tables, I have referred both to the returns of the Civil as well as of the Military Services, and although discrepancy of results does sometimes appear, yet circumstances, which will hereafter be alluded to, account for these apparent differences. The following tables are formed with a strict view to the development of the foregoing observations. Columns consecutively placed, shew at one view, the number of patients admitted, their classification into Endemic and Epidemic diseases, and subsequent mortality. A slight amplification of the Epidemic diseases appeared necessary, and two columns under this head, shew the number of small-pox and cholera patients, not only Abstracts for the different years, but likewise for the different months have been shewn,—as in all tropical climates the regularity of the monsoon, exerts a considerable influence upon the health of the inhabitants. I may here add, that the three Appendices, marked A. B. C., are from the official reports from the three Hospitals in the Station,—Military, Civil and Jail; and as every individual case is registered, the results must be correct.

2. The Report A. is the most valuable, as the patients there exhibited, being Mughs and Sepoys of the Arracan Local Battalion, assimilate to the natives of the Province in every particular. The Burkundauz on the contrary, are chiefly natives of the adjoining parts of Bengal, and the prisoners are composed mostly of men who have been transported from Bengal and the North Western Provinces. This consideration is of the utmost importance, as by it certain discrepancies in result, can be clearly accounted for. I allude, of course, to the prevalence of disease in Arracan. In the Report A. the most singular feature, and one which becomes immediately apparent, is the immense amount of sickness arising from Endemic causes in the year 1838. More than one-half the patients admitted, appeared to have suffered from diseases which have arisen from locality alone; and it is gratifying to observe the gradual improvement of this class of disease up to the year 1842, which satisfactorily

proves the influence of judicious means to counteract the effects of a bad climate. In 1843, the number of Endemic patients was much greater than in the former year, but relatively with the number admitted, not much difference is discernible. The most interesting part, however, of this Appendix, is the number of patients admitted in each year. Although the Battalion is nearly 1,000 strong, still it must be observed, that the usual number at Head Quarters is 693. In the year 1839 and 1840, upwards of 600 men were admitted each year, while in 1843, no less a number than 752 were admitted, being 59 patients more than men at Head Quarters. This curious result is accounted for by some being re-admitted, death vacancies being filled up, and out-post guards being relieved. The first six months, however, of the present year, a still greater amount of sickness is observable, 507 registered patients having been treated in the Regimental Hospital, being at an average of 1,014 patients in the course of the year. Regarding this number, therefore, with respect to the number at Head Quarters of the Battalion, the amount of sickness is about 146 per cent. per annum.

3. In referring to the same Appendix, and regarding the influence which Epidemic diseases appear to have exerted in producing these varied results, it appears, that up to the year 1843, cholera was the only Epidemic which has shewn itself, and then only in the year 1841, to any very great extent. In the year 1843, a disease not before noticed in the Reports of the former six years (although it has always prevailed throughout the Province, especially in the hot months, but never to any great extent), fully developed itself; 104 cases of small-pox were admitted; its character was not of an ordinary nature, confluent to a most frightful degree; the patient was admitted, himself despairing of the result. Superstition, bigotry, and prejudice seem, in almost every case, to have bound his savage and uneducated mind to the dogmas of his priests; and by the most vigilant care on the part of the military executive, this undue and prejudicial influence could not be entirely counteracted. Sacred earth was spread over his body; he put no faith in medicine not blessed by his priests; and the consequence was, despair and subsequent death. So violent, indeed, was this frightful disease, that many of those, who at the time recovered, lived for a short time to drag out a miserable existence,

either blind, or so injured in constitution, as to be useless as soldiers, and consequently discharged the service; not a few died of dropsy; and others on sick leave. The regiment was removed several miles into the jungle and placed in tents, since which time not a single case has appeared; subsequent to the disappearance of small-pox amongst the men of the Local Battalion, cholera broke out, and 36 cases occurred in five months. Both of these Epidemics ceased, on the setting in of the rains.

4. The Appendix B. is an abstract of the Jail Hospital Reports for the last six years and a half, arranged, as in the former case. Epidemic disease has shewn itself slightly, compared with the former Report. The amount of sickness on the contrary is very remarkable; in every year it has exceeded the number of prisoners, and in the year 1841, the proportion of sickness to strength was nearly four to one. The class of diseases which makes up this large amount, becomes immediately obvious on referring to the Appendix. Out of the total number of patients admitted, nearly one-half were suffering from Endemic diseases; a result, however, which is not surprising, when it is considered, that most of the prisoners in the Akyab Jail had been transported for life from Bengal and the North Western Provinces; and of these, the greater number are murderers and thugs. The confinement of a jail alone, after their former wandering life, will have a material influence in predisposing to disease, without considering the influence of the mind, which in the case of religious enthusiasts, like the thugs, will be of the first importance,—morose; the evil propensities of their nature entirely checked; deprived of liberty; working in irons in a foreign country day after day; sentenced perhaps at an advanced age; exposed to the extreme vicissitudes of climate, rain and heat; probably men who never before experienced severe bodily labor,—Is it singular that such a result should be attained? On the contrary, the amount of sickness is very small, when the foregoing circumstances are taken into consideration. And this result is to be attributed to the excellent regulations of the executive, which are strictly enforced. I am alluding to cleanliness, diet, and regularity of habits. This power in regulating the domestic habits of prisoners, is entirely lost in other classes; and it is a curious fact, that although in the case of life prisoners, there is a proportion of nearly two or three times

the amount of sickness with that of the Local Sepoys, yet the relative mortality with regard to disease is much the same; proving by irrefragable evidence, the influence of irregular habits, improper food, and dissipation.

5. In Appendix C., which is an abstract of patients admitted into the Sudder Hospital, there is no prominent feature to which to direct attention, unless the fact, that a large amount of sickness annually prevails; but this is accounted for by the fact, that the men composing the force are constantly on duty, exposed to all the changes of climate: but although these duties do not admit of much dissipation, it must be observed, that they are a people of dirty and irregular habits. Only two recorded cases of small-pox occurred in six years and a half, and forty-nine cases of cholera in the same period. This report proves the great amount of Endemic disease, and is valuable on no other account.

6. Appendix D. is a series of comparative abstracts from Official Papers, shewing the effect the climate of Arracan has on European constitutions. Out of a total number of 62 European Officers, Civil and Military, more than one-fifth died in the Province, and eleven were compelled to leave for Europe, on account of sickness induced from local residence. The Military Officers have suffered more than the Civil, and this is to be attributed to the greater exposure to which they are subjected. In six years, four Military Officers have died in the Province out of twenty-eight; whereas only two Civilians died out of thirteen, in eleven years. The effects of frequent and improper exposure to the noxious influence of the climate, is shewn in the mortality of the Executive Engineers and Medical Officers. The ultimate distribution of four Executive Officers is as follows:—two died, one exchanged, one present; but the number is too small for a correct ratio. Not so, however, with Medical Officers, no less a number than seventeen have been attached to Akyab in eleven years. In the first five of these eleven years, only one Medical Officer at a time performed the double duty, but as the place increased, the Civil and Military Arm gave one Medical Officer each. The mortality exclusive of those present, is just one-third, and about one-fourth have left the Province for Europe on account of sickness induced from the

climate. This painful result is to be attributed to the exposure which a Medical Officer is always subject to in Arracan,—the damp dews and marsh miasma of night, and the perpendicular rays of a tropical sun by day; the result proving by irrefragable evidence, the influence of these two extremes. At the same time it is to be observed, that almost every Officer, whether Civil or Military, in the Station, has suffered severely from one of the varied types of fever, most commonly the intermittent and remittent, and a few from continued fever; but not one case is recorded of an Officer dying from a mere Epidemic disease.

7. The following table will shew the number of registered native patients in six years, with the corresponding proportion of Endemic and Epidemic diseases placed consecutively:—

		Endemic diseases.	*Epidemic.*	
			Small-pox.	*Cholera.*
Arracan Local Battalion. Number of Patients admitted in six years,	3,539	1,510	104	122
Jail Hospital. Ditto ditto, ...	2,591	1,171	6	83
Sudder Hospital. Ditto ditto, ...	1,344	600	...	46
Total in six years, ...	7,474	3,281	110	251

The proportion which Endemic diseases bear to the number of patients, in the above Register, is more than 43 per cent. Epidemics on the contrary do not amount to 5 per cent. Of this amount 104 cases of small-pox occurred and were registered in the Regimental Hospital in the year 1843, which is not quite a third of the whole number of Epidemic diseases in six years.

8. From the statistical remarks before alluded to, it appears that sickness is greatly on the increase in Akyab, and in analyzing its character, it is found not be confined to any particular class of disease. In the year 1843 and the early part of 1844, the number of Endemic diseases nearly doubled the amount of the number in 1842. Epidemics, in the before-mentioned period, raged with so much violence,

that the number of individuals attacked, bears no proportion to former years. This double remark applies to almost every village in the Province. The consideration, therefore, of the causes which induce so painful a result, will be of the first importance. Cholera, small-pox, and fever in all its varied phases, have been the cause of this increase of sickness, and consequent mortality.

9. With respect to sanatory suggestions for the suppression or amelioration of cholera, so much diversity of opinion hangs over the subject, that it will be useless to refer to its consideration with regard to specific measures. The subject of locality, bad food, &c., will be deferred to an after part of this report, as these considerations influence all disease; and a more general view of this important subject can then be taken.

10. Small-pox happily admits not only of palliation in progress, but of almost positive suppression. The merits of vaccination are so well acknowledged, and its powerful and general application so well understood, that it would be superfluous to urge the necessity of its adoption universally, throughout the province. To allude, however, to the difficulties attending its introduction amongst the *Mughs,* will certainly not be irrelevant to the subject in consideration. I need only refer to the satisfactory and gratifying result of vaccination in Ramree; where prejudice, and no ordinary degree of superstition have been overcome by energy and talent, and when the result proves the feasibility of its introduction. One of the difficulties attending the introduction of vaccination, is the silent acknowledgment of inoculation by the executive. The Mughs have for years been taught to consider inoculation as the only preventive against small-pox, and this idea has been fostered, and its pernicious doctrines inculcated by their Phoongyees, or priests, who at the time of its dissemination, invest the act with a certain degree of superstitious veneration, and numbers have in consequence been sacrificed. On the contrary, when a person in England dies after and from the effects of inoculation, the inoculator is held to be criminal, and the act subjects him to the law accordingly. On these grounds, I would recommend, that every practicable means be adopted to discourage the practice of inoculation by the Government; to combat the previous effects of ignorance must be

left to the assiduity of the Medical Officer: but all his effects will be nullified, his energies frustrated, and he himself will experience the mortification of a failure in a good and benevolent cause, if his varied efforts are not warmly and energetically seconded by the executive.

11. The following are amongst the principal causes which produce Endemic disease:—Geographical and relative position; imperfect drainage, and diseased vegetation with their united effects; impure water and food, combined with an imperfect ventilation and crowded population. The operations of the mind, which in a civilized country exert so powerful an influence on the inhabitants in predisposing to disease, is of so little importance, and the effects are so slight in a barbarous people, that its consideration does not require any prominent attention in a local report like the present. The other causes of disease, however, previously mentioned, will be considered with reference to Akyab; and the importance of this consideration is considerably increased, when it is mentioned, that the same causes which induce Endemic disease, exert a very material influence in propagating the Epidemic form, not only in number but severity.

12. The geographical and relative position of Akyab, is peculiarly adopted for the development and propagation of disease, being exposed to all the violent and sudden changes of heat and rain, which is only experienced in a tropical climate situated on a loose, sandy soil, with an elevation but little beyond high-water mark; bounded on three sides by jungle, jheel and marsh, and on the fourth, by an estuary; with the wind blowing for nearly half the year over hundreds of miles of unexplored jungle, previous to reaching the station; and marsh miasma and noxious gases of every description, the result of animal and vegetable putrefaction rising in every direction. All these considerations point out the situation as being highly detrimental to health; but at the same time demand the most active measures to endeavour to counteract the evil influence of a position which cannot be remedied, but which has been, and still can be, much improved by human exertion and perseverance.

13. In alluding to diseased vegetation and imperfect drainage, it will not be irrelevant to the question, to consider, that healthy vegetation in the exercise of its functions, exerts a beneficial influence over

the atmosphere, by absorbing deleterious, and giving out healthy, gases, but it is equally certain, on the contrary, that the moment vegetation becomes unhealthy, a marked change takes place, and its powers of assimilation are either entirely lost, or so far impaired, as to become, by a languid action, almost useless; not only does this change in function take place, which would only give a negative result, but an active injury ensues, and deleterious gases are thrown off, where formerly, and in a state of health, these gases were of an opposite tendency. Supposing, however, as it happens in many cases, death of the vegetable substance, decomposition ensues, which is even worse than the former case. The deduction, therefore, is that any thing which tends by its presence, or otherwise, to produce diseased vegetation, should be sedulously avoided. A crowded vegetation is especially injurious, as the plants become diseased from want of light, air, and nourishment,—the three essentials for health in the animal as well as the vegetable kingdom. By applying this rule to the gardens and compounds of the native population of Akyab, abundance of room is found for the exercise of remedial influence. Trees of all descriptions, and of the most miscellaneous character are crowded together in the smallest possible space, not only causing decomposition by the death of the weakest plants, but, as will be hereafter shewn, impeding ventilation and drainage. This is an evil which demands correction. In the very heart of the town, vegetation springs up in the most heterogeneous confusion, and the greatest quantity appears to exist in the exact ratio with the number of inhabitants; the existence of a few houses in any particular spot, is the sure nucleus for vegetation; and this is the first commencement of the evil.

14. The drainage of a place like Akyab is attended with difficulties not often met with, and the principal difficulty consists in the geological nature of the ground. The whole town is situated on a loose sandy soil, which appears to have been thrown up by the sea, and superimposed on a ridge of sandstone, which takes its origin at the Fakeer's rock, and extends across the island to the Myoo river, in a north-westerly direction. The town being situated on the banks of an estuary from which the soil was formed, it is but at a very slight elevation from the surface of high-water mark; and this is the re-

servoir into which the drains of the town flow, and the larger of these which pass through the town are nothing more than smaller estuaries, into which, of course, the tide rises twice in 24 hours. It is therefore of the utmost importance, that they should be kept constantly free of every thing in the shape of impediment to the free passage of water, and for this purpose it would be advisable to clean them thoroughly, and dam up the banks with the refuse from the centre. Houses placed on their immediate margin, are very injurious to the integrity of the current, as the banks are worn away by the driving of piles, &c. There should be a broad road on each side of all the drains in the town, and the banks could be strengthened by judiciously planting the vicinity, with large arboraceous trees.

15. The remarks in the foregoing paragraph refer to all the smaller estuaries in the vicinity of Akyab, but they are particularly applicable to the largest of them, called the "Pyke tœ kyong" or "Fisherman's Nullah," and marked in the Map *a*. It takes its rise at the Regimental magazine, and after passing in a circuitous course through the town, empties itself at right angles with the harbour. The paving with stone, that portion of the drain into which the tide rises, would be of much advantage, and would materially assist in preventing the banks from falling in; which, from the nature of the soil, is an accident very likely to occur. There is another nullah which likewise deserves to be mentioned, it is marked in the Map *b*. and empties itself close to the flag-staff. At every spring tide the water flows over its boundaries, and acres of ground are covered with salt water, which, as it is close to the station, is of incalculable injury. This nullah requires bunding, so as to keep the current of water in its natural course.

16. The ground from which the jungle has recently been removed, situated on the sea beach, *c. c.* requires draining as far as practicable, to obtain that beneficial influence which must ultimately accrue from the removal of so much diseased vegetation. At present the sea water covers very frequently a great portion of this ground, and it is in consequence not only injurious in a sanatory point of view by encouraging decomposition, but wholly prevents the ground from being reclaimed for agricultural purposes.

17. The gases which result from vegetable decomposition, and which form that deleterious atmosphere, known by the name of marsh miasma, is specifically heavier than atmospheric air. To dissipate this evil, it is necessary that currents of air should pass as near to the surface of the ground as practicable; every thing impeding this influence should be removed, or if this is found to be impracticable, care should be taken to prevent the accumulation of gas. It is upon this principal that the paddy cultivation between the station and the town should be suppressed. The ground marked in the Map *d. d. d.* whereon this cultivation takes place, is a hollow over which the wind passes; but from the peculiar concave formation of the spot, its influence is exerted not immediately over the surface of the ground. The growth of paddy is likewise objectionable here, from the nature of the cultivation in question, when it occurs in a sandy soil, and which from its slight elevation hardly admits of perfect drainage. It is at the commencement and termination of this paddy cultivation, that its immediate effects are more immediately felt; in the first place by disturbing the surface of the ground, and in the second place by allowing the residue of the paddy to remain, and not on a loose soil which is always subject to periodical changes, no hardness can take place which is of the first importance. It is recommended to convert these paddy fields into pasture grounds; and the drainage could be assisted, and the appearance improved, by the formation of roads throughout their whole extent, or a cultivation of wheat and barley, which does not require so much moisture as paddy, might be encouraged.

18. On the south bank of the Charoogia Creek, there exists a jungle of the most deleterious character. It extends from the opening of the creek to the ghat marked in the Map *e. e. e.*; it is bounded by the Ong-ta-beng road, covered with mangrove jungle, growing out of a low muddy slip of ground without any pretensions to drainage, and over which the sea flows at its every influx. I know of nothing which would tend more to the health of the inhabitants, generally, than the removal of this jungle and draining the ground; and I would earnestly urge this suggestion on the consideration of the executive, as one eminently calculated to check the prevalence of disease. It is likewise with the same view that I would recommend the removal

of the low huts and vegetation marked in the Map *f.*, situated between the flag-staff and burial ground. The native habitations few in number, form the nucleus of all manner of filth and diseased vegetation, and as this spot is the only place where the sea air can come direct to the station, the inducement for its removal has an additional claim from this consideration.

19. On the subject of food, but little can be done in a sanatory point of view, with the exception of suggestions for the removal of the present fish market. The Mughs eat largely of fish: on account of its abundance and consequent cheapness, it becomes necessarily the staple article of food. To prevent by police regulations the sale of bad fish, is certainly of paramount importance, but as the fish market is at present constituted, decomposition speedily takes place. The fish is at present exposed for sale on the ground, in the heart of the town, surrounded on every side with houses, and acted upon directly by the rays of the sun, as no roof is erected in the present constituted state of the market. A raised pucca market built by the side of the water with a bamboo roof, would be most desirable, and would contribute, not a little, to the general health of the inhabitants; as the market could be so arranged, that all the refuse could be carried off by the first ebb-tide.

20. In alluding to the subject of water in an alimentary consideration, but few conveniences exist for the native population of the town. In the rainy season each inhabitant digs a deep hole in his compound for the purpose of catching the rain-water; this hole partially fills up, and from the loose nature of the soil, the sides give way, great hollows are formed, which soon become filthy swamps. In the dry weather the people resort to tanks or nullahs, the latter of which are generally brackish from the mixture of sea-water. The sides of these reservoirs are filthy beyond description, and swarm with vermin. No doubt can possibly exist as to the perniciousness of this practice, and disease is an inevitable consequence. In the whole of Akyab and its neighbourhood but two public wells have been constructed, and this is principally for the convenience of the shipping. It is true that one large well has been erected at the private expense of a solitary individual for the sake of the public good, but only tends to shew the ab-

solute necessity of increasing the number in the town of Akyab. According to the last census, there was a population numbering 4,966 souls, while in the suburbs of the town, there were 9,291, making the total number of human beings 14,257, which number excludes the Government servants and prisoners. To supply the wants of these people only, the conveniences before alluded to exist. The necessity for wells likewise in a sanatory point of view, is the more cogent, when it is again remembered, that all the natural reservoirs are brackish from the admixture of salt water. Every suburb should be supplied with its well, and there should be an addition of several in the town of Akyab; their construction is much too expensive for private enterprize, as the sides require to be made with pucca materials; and they should be kept clean under police regulations.

21. One of the principal sanatory suggestions which will be remarked upon, yet remains to be spoken of,—the evils of a crowded population, increasing the difficulties of free ventilation and drainage. There are parts of the town of Akyab where, from the greater number of inhabitants, the greatest quantity of filth is accumulated, and these are situations in low swampy places on the borders of the large nullahs, and where good drainage is peculiarly difficult of attainment. Men, women, animals, and rank vegetation are huddled together in the most curious and heterogeneous confusion; and by their presence, impeding ventilation, preventing drainage, and producing disease from decomposition of the filth accumulated. This congregating together in detached bodies, seems originally to have had its origin in a feeling of mutual support, and is seen in all barbarous people over the face of the globe. So strong is this early and natural impression, and so sedulously is the principle inculcated by example, that the most stringent regulation on the part of the executive is necessary to prevent so pernicious a practice from taking place.

22. Although some parts of the town of Akyab have been laid out in the most judicious manner, there are others in which the evil complained of, demands immediate attention, or the mischief will be rapidly increased; it will be necessary to find out the most expeditious and at the same time easy mode, by which the evil complained of can be suppressed; and the plan which offers the most convenience is, by the

formation of long and wide streets, wherever the houses are thickest, and the jungle-gardens most extensive. On the Map, the lines colored purple, represent the proposed streets. Ventilation, drainage, cleanliness, facility of access, and the easy suppression of fire, are all combined in this suggestion, and these considerations are of the utmost importance in a native town. The formation of these streets will indubitably have a most beneficial effect on the health of the inhabitants, but the principle on which their construction rests, is one which cannot be too extensively carried out, and I beg to attract the special attention of the authorities, to the necessity of their giving it their most special attention.

23. There are various other considerations in the extensive subject, which has been passed over, on the supposition either that the report might become too prolix, or the propriety of the subject in such a place, might be questioned. I allude principally to education. It is by this means alone that the moral condition of the Mugh can be effectually and permanently improved, and it is to this means we naturally look for an amelioration of his present debased habits. It will, I am afraid, be considered irrelevant to the subject to point out and urge the adoption of this plan, to prevent disease by elevating the moral and social condition of the man, and I therefore reluctantly relinquish the subject.

24. It has been shewn that nearly half the diseases arise from locality alone, but much has been done to raise what was formerly a wretched swamp to a large town, full of human beings, in comparatively few years. The reflection of this fact, however, would only give new zest for an increase of exertion, and my endeavour has been to point out in a practical manner, and to which I have given a practical application, remedies for the suppression of disease. Sedulously avoiding the use of scientific terms, and endeavouring to discover a means of ameliorating and elevating the condition of the people, by first analyzing a popular, general and acknowledged law, and subsequently shewing its application to the case in point. By these means debatable ground has been avoided, and I have striven to found the foregoing sanatory observations on principles of acknowledged truth.

APPENDIX [A.]

An Abstract shewing the number of Patients admitted into the Hospital of the Arracan Local Battalion from the year 1838 *to the year* 1843, *and the* 1*st six months of* 1844, *with the number of Endemic and Epidemic Diseases, and the number of Deaths.*

	1838.					1839.					1840.				
			Epidemic.					Epidemic.					Epidemic.		
	Patients admitted.	Endemic diseases.	Small pox.	Cholera.	Deaths.	Patients admitted.	Endemic diseases.	Small pox.	Cholera.	Deaths.	Patients admitted.	Endemic diseases.	Small pox.	Cholera.	Deaths.
January, ...	55	30	0	0	0	55	31	0	0	1	55	26	0	2	3
February, ...	48	27	0	0	0	39	16	0	0	1	61	25	0	0	2
March, ...	47	8	0	1	3	49	20	0	0	2	50	17	0	0	1
April, ...	47	25	0	0	3	29	11	0	8	5	35	11	0	0	0
May,	73	36	0	0	1	52	11	0	23	15	40	5	0	0	0
June,	35	25	0	0	0	36	18	0	7	8	34	8	0	0	0
July,	46	29	0	0	2	28	10	0	0	2	52	8	0	15	7
August,	29	20	0	0	1	59	15	0	0	1	34	5	0	2	4
September,...	31	11	0	0	3	52	6	0	0	2	47	15	0	2	0
October, ...	51	26	0	0	3	62	17	0	0	0	84	47	0	1	1
November, ...	60	29	0	0	1	88	55	0	1	0	66	34	0	3	1
December, ...	71	44	0	0	2	99	53	0	0	0	65	32	0	0	1
Total, ...	593	310	0	1	19	648	263	0	39	37	623	233	0	25	20

	1841.					1842.					1843.				
			Epidemic.					Epidemic.					Epidemic.		
	Patients admitted.	Endemic diseases.	Small pox.	Cholera.	Deaths.	Patients admitted.	Endemic diseases.	Small pox.	Cholera.	Deaths.	Patients admitted.	Endemic diseases.	Small pox.	Cholera.	Deaths.
January, ...	53	22	0	0	0	23	10	0	0	0	100	67	0	0	1
February, ...	35	21	0	0	1	44	16	0	0	0	62	42	1	0	1
March, ...	38	16	0	0	1	59	18	0	0	1	71	35	5	0	0
April, ...	44	20	0	2	3	25	11	0	0	2	45	14	1	1	2
May,	54	10	0	31	19	35	14	0	0	0	43	13	3	1	4
June,	32	11	0	13	5	25	12	0	0	0	49	13	4	0	1
July,	28	14	0	0	1	24	12	0	0	1	40	14	9	0	2
August,	35	19	0	1	1	24	6	0	0	0	42	17	9	1	10
September,...	32	13	0	1	1	29	9	0	0	1	44	18	8	0	0
October, ...	51	22	0	0	0	26	8	0	0	0	60	23	12	0	3
November, ...	55	19	0	1	1	62	28	0	0	2	76	30	17	1	8
December, ...	36	11	0	1	1	54	26	0	2	1	120	50	35	1	14
Total, ...	493	198	0	50	34	430	170	0	2	8	752	336	104	5	46

	1844.				
			Epidemic.		
	Patients admitted.	Endemic diseases.	Small pox.	Cholera.	Deaths.
January, ...	97	35	21	6	11
February, ...	43	8	1	10	12
March,	85	26	0	3	0
April,	108	35	0	15	10
May,	97	64	0	2	4
June, ...	77	49	0	0	1
Total, ...	507	217	22	36	38

	Patients admitted.	Endemic diseases.	Epidemic. Small pox.	Epidemic. Cholera.	Deaths.	Other diseases accidents, &c. &c.
Total of 1838	593	310	0	1	19	263
1839	648	263	0	39	37	309
1840	623	233	0	25	20	345
1841	493	198	0	50	34	211
1842	430	170	0	2	8	250
1843	752	339	104	5	46	261
Total of 6 years.	3539	1510	104	122	164	1639

N. B. This report only embraces those Sepoys at the Head Quarters of the Battalion, in number 693, and who were treated in the Regimental Hospital. A great number of men die on command and sick leave.

APPENDIX [B.]

An Abstract shewing the number of Patients admitted into the Jail Hospital of Akyab, from the year 1838 *to the year* 1843, *and the* 1*st six months of* 1844, *with the number of Endemic and Epidemic Diseases, and the number of Deaths.*

	For 1838.	Patients admitted.	Endemic diseases.	Epidemic.		Deaths.	For 1839.	Patients admitted.	Endemic diseases.	Epidemic.		Deaths.	For 1840.	Patients admitted.	Endemic diseases.	Epidemic.		Deaths.
				Small pox.	Cholera.					Small pox.	Cholera.					Small pox.	Cholera.	
January, ...	Aver. No. of Prisoners 156.						Aver. No. of Prisoners 149.	18	2	0	1	0	Aver. No. of Prisoners 154.	18	3	0	1	1
February,		30	7	0	0	0		11	0	0	0	0		8	0	0	0	0
March, ...								21	1	0	3	2		15	0	0	0	0
April, ...								28	2	0	9	2		11	1	0	0	0
May, ...		54	16	0	2	0		19	3	0	3	1		40	4	0	0	0
June, ...								20	1	0	3	0		37	5	0	0	0
July, ...								15	1	0	0	0		86	32	0	0	0
August, ...		61	37	0	0	0		11	0	0	1	0		33	16	0	1	5
September,								27	0	0	1	1		34	15	0	0	1
October, ...								18	1	0	4	2		41	16	0	6	6
November,		36	14	0	0	0		20	6	0	1	0		56	27	0	6	0
December,								21	9	0	0	0		41	24	0	1	2
Total, ...		181	74	0	2	0		229	26	0	26	8		420	143	0	15	15

	For 1841.	Patients admitted.	Endemic diseases.	Epidemic.		Deaths.	For 1842.	Patients admitted.	Endemic diseases.	Epidemic.		Deaths.	For 1843.	Patients admitted.	Endemic diseases.	Epidemic.		Deaths.
				Small pox.	Cholera.					Small pox.	Cholera.					Small pox.	Cholera.	
January, ...	Aver. No. of Prisoners 180.	54	30	0	0	0	Aver. No. of Prisoners 252.	31	22	0	0	2	Aver. No. of Prisoners 410.	65	42	0	0	2
February,		68	52	0	0	0		26	19	0	0	2		34	19	0	0	3
March, ...		76	65	0	1	3		44	24	0	0	2		56	27	0	1	4
April, ...		58	36	0	0	1		18	5	0	0	2		46	8	0	0	3
May, ...		68	43	0	12	10		16	3	0	0	2		37	11	0	0	0
June, ...		57	24	0	0	1		28	10	0	0	4		26	11	0	0	2
July, ...		74	42	0	0	1		50	24	0	0	4		37	19	0	0	5
August, ...		58	46	0	1	1		69	24	0	0	2		56	13	0	0	1
September,		47	33	0	1	5		41	11	0	1	2		48	20	0	0	0
October, ...		36	14	0	0	1		68	28	0	2	4		27	7	0	0	3
November,		46	31	0	0	3		65	45	0	0	1		45	16	0	5	2
December,		46	27	0	0	2		68	46	0	1	4		73	31	6	15	23
Total, ...		687	443	0	15	28		524	261	0	4	31		550	224	6	21	48

	For 1844.	Patients admitted.	Endemic diseases.	Epidemic.		Deaths.			Patients admitted.	Endemic diseases.	Epidemic.		Deaths.	Other diseases accidents, &c. &c.
				Small pox.	Cholera.						Small pox.	Cholera.		
January,	Aver. No. of Prisoners 493.	61	38	4	2	3	Total of	1838	181	74	0	2	0	105
Feby. ...		35	15	0	2	1		1839	229	26	0	26	8	169
March,		35	13	1	1	2		1840	420	143	0	15	15	247
April, ...		36	15	0	1	2		1841	627	443	0	15	28	201
May, ...		55	27	0	2	2		1842	584	261	0	4	31	228
June, ...		30	13	0	0	1		1843	550	224	6	21	48	251
Total, ...		252	121	5	8	11	Total of 6 years.		2591	1171	6	83	130	1201

APPENDIX [C.]

An Abstract shewing the number of Patients admitted into the Sudder Hospital at Akyab, from the year 1838 *to the year* 1843, *and the* 1st *six months of* 1844, *with the number of Endemic and Epidemic Diseases, and the number of Deaths.*

	1838. Patients admitted.	1838. Endemic diseases.	1838. Epidemic. Small pox.	1838. Epidemic. Cholera.	1838. Deaths.	1839. Patients admitted.	1839. Endemic diseases.	1839. Epidemic. Small pox.	1839. Epidemic. Cholera.	1839. Deaths.	1840. Patients admitted.	1840. Endemic diseases.	1840. Epidemic. Small pox.	1840. Epidemic. Cholera.	1840. Deaths.
January, ...	35 (Jan.–March)	15	0	0	0	14	4	0	0	0	9	5	0	0	1
February, ...						12	5	0	0	1	11	3	0	0	1
March, ..						14	3	0	0	0	13	4	0	0	0
April, ...	38 (April–June)	20	0	0	0	19	2	0	3	2	13	5	0	0	1
May,						16	3	0	2	4	20	12	0	1	0
June,						15	6	0	2	1	18	10	0	0	0
July,	49 (July–Sept.)	29	0	0	1	19	8	0	2	1	47	28	0	6	5
August,						13	6	0	1	1	22	11	0	1	1
September, ...						15	5	0	1	0	25	9	0	3	1
October, ...	23 (Oct.–Dec.)	5	0	0	1	20	11	0	0	1	16	6	0	1	3
November, ...						11	3	0	0	1	19	11	0	0	0
December, ...						16	6	0	0	0	12	5	0	0	0
Total, ...	145	69	0	0	2	184	62	0	11	12	225	109	0	12	13

	1841. Patients admitted.	1841. Endemic diseases.	1841. Epidemic. Small pox.	1841. Epidemic. Cholera.	1841. Deaths.	1842. Patients admitted.	1842. Endemic diseases.	1842. Epidemic. Small pox.	1842. Epidemic. Cholera.	1842. Deaths.	1843. Patients admitted.	1843. Endemic diseases.	1843. Epidemic. Small pox.	1843. Epidemic. Cholera.	1843. Deaths.
January, ...	25	10	0	0	0	20	9	0	0	0	35	24	0	0	0
February, ...	24	14	0	0	0	16	11	0	0	0	15	8	0	0	0
March, ...	30	25	0	0	0	30	10	0	1	1	27	13	0	0	0
April, ...	27	16	0	3	2	17	7	0	0	0	12	2	0	0	0
May,	23	8	0	10	10	16	8	0	0	0	22	7	0	0	0
June,	22	9	0	2	1	14	6	0	0	1	17	4	0	0	2
July,	28	15	0	0	0	20	5	0	0	0	27	12	0	0	0
August,	39	14	0	1	0	18	10	0	0	1	29	11	0	0	1
September, ...	23	9	0	0	0	11	2	0	0	2	14	4	0	0	0
October, ...	15	8	0	0	1	17	7	0	0	0	19	3	0	0	0
November, ...	15	7	0	1	0	33	18	0	0	0	23	9	0	3	2
December, ...	20	4	0	0	0	29	20	0	0	1	18	11	0	2	2
Total, ...	291	139	0	17	14	241	113	0	1	6	258	108	0	5	7

	1844. Patients admitted.	1844. Endemic diseases.	1844. Epidemic. Small pox.	1844. Epidemic. Cholera.	1844. Deaths.
January, ...	20	13	2	0	0
February,	14	5	0	0	0
March,	11	4	0	0	0
April,	19	5	0	1	1
May,	9	6	0	2	1
June, ...	14	9	0	0	0
Total, ...	87	42	2	3	2

	Patients admitted.	Endemic diseases.	Epidemic. Small pox.	Epidemic. Cholera.	Deaths.	Other diseases accidents, &c. &c.
Total of 1838	145	69	0	0	2	74
1839	184	62	0	11	12	99
1840	225	109	0	12	13	91
1841	291	139	0	17	14	121
1842	241	113	0	1	6	121
1843	258	108	0	5	7	138
Total of 6 years.	1344	600	0	46	54	644

N. B. The average number of Burkundauz classes, &c. &c. is about 240.

APPENDIX [D.]

Shows the ultimate distribution of Military Officers in Akyab for the last six years, and Civil and Medical Officers for the last eleven years.

	Present.	Transferred to Civil employ.	Exchanged.	Resigned in the Province.	Sick certificate to Calcutta where they resigned.	Sick certificate to Europe.	Died.	Total each service.
Military commissioned and non-commissioned Officers from 1838 to 1843 inclusive, ...	8	1	0	6	3	6	4	28
Civil Officers from the year 1833 to 1843 inclusive, ...	6	0	0	4	0	1	2	13
Executive Engineers, ...	1	0	1	0	0	0	2	4
Medical Officers of the Civil and Military Departments, from 1833 to 1843 inclusive, ...	2	1	1	2	2	4	5	17
Total,......	17	2	2	12	5	11	13	62

(Signed) C. ARCHER, M. D.

Assistant Surgeon, in Medical Charge, A. L. Batt.

(True Copies)

A. TURNBULL,

Under-Secretary to the Govt. of Bengal.

Report of the Chemical Examiner to Government, from November 1841, *to April* 1844, *inclusive. By* FREDERIC J. MOUAT, M. D., *late Chemical Examiner.*

From the difficulty of classifying and arranging the various subjects embraced in this report, and presenting a condensed view of the results obtained, the following artificial arrangement is adopted :—

I. Cases of real and supposed poisoning, or in which substances conjectured to be poisonous, were presented for examination.

II. Investigations undertaken for the Military Board.

III. Analyses performed for the Salt Department.

IV. Miscellaneous subjects.

SECTION I.

The number of analyses performed in cases connected with this division, was not very great, but the minute and elaborate investigation, necessary in many instances, occupied a large amount of time, and required repeated experiments to avoid every source of fallacy, where the life or death of an accused person, depended upon the result.

The care and attention required in India, are greater than in the majority of medico-legal investigations in Europe, from the impurity of almost all the tests, which can be procured from the public stores; so much so, that in many instances, it was necessary to prepare some of them in the laboratory of the Medical College.*

A large proportion of the cases of poisoning, which have heretofore occurred, appear to have been from the administration of arsenic and its compounds, probably from their cheapness and abundance in the bazaars. These have been detected in every instance, and were in general given in such quantities, as to leave ample and indisputable traces of their existence. Latterly, however, the vegetable

* This was always done by Mr. Andrew Robertson, the present Lecturer on Chemistry in that Institution, whose scientific skill and practical knowledge were frequently employed in cases of doubt and difficulty, in which they were always cheerfully and readily afforded, although the office of Chemical Examiner had no distinct or immediate connection with his own appointment.

poisons have been more resorted to, from its being known to Hakeems and native druggists, that while minute traces of any mineral poison can be unerringly discovered, the greater number of vegetable substances defy analysis and identification after administration, in the present state of chemical science. Some check might nevertheless be put to the amount of murder committed in this way, unknown and unrecorded, by a legislative enactment punishing all venders of drugs, in whose possession well-known and deadly poisons are found; for although they are occasionally used in the native treatment of disease, the greater quantity is purchased by dacoits and vagabonds of all kinds, upon the persons of many of whom they are frequently discovered when apprehended and brought to trial.

This subject is therefore prominently noticed, from a conviction that much good would result, and the class of professional poisoners be discovered and punished, if the possession of poisons and open sale of them were interdicted, and rendered the offenders liable to fine or imprisonment.

Case 1st.—A case in which death occurred from the administration of arsenic,—sent for examination by Mr. Wheatly, 1st Junior Assistant, Seoni Office. The poison was present in large quantity, and the death certified to have been produced by its exhibition.

Case 2nd.—A case which occurred at Gya,—forwarded by Mr. E. Drummond. The stomach and intestines were examined and found to contain a quantity of the yellow sulphuret of arsenic, more than sufficient to have caused death.

Case 3rd.—A bottle of brandy, in which, a resident of Calcutta imagined some poison had been introduced. None was discovered, nor was there reason to believe, that any thing, but stimulating aromatic substances were present.

Case 4th.—A portion of a stomach and its contents,—sent from Ghazeepore, in which death had resulted from some substance mixed with suttoo, which had been eaten by the deceased. It was found to contain arsenious acid.

Case 5th.—A portion of a suspicious looking substance, found in the soup of His Excellency the Commander-in-Chief,—sent for examination by Assistant Surgeon Gurney Turner. Found to be some vegetable gum-resin, most probably used as a condiment.

Case 6th.—The stomachs, portions of the great blood vessels, and the fluid found in the former, of two prisoners in the Allipore Jail, who had died under very suspicious circumstances,—sent by Dr. Strong, Surgeon 24-Pergunnahs.

No poison was discovered, but from the history of the cases, the symptoms and appearances after death, and the moral evidence produced, there was no doubt that life had been destroyed by a vegetable narcotico-acrid poison, most probably aconite or stramonium, or possibly a mixture of the two.

Case 7th.—Lieut. Martin of the Engineers, who died in Arracan under suspicion of poisoning, was examined after death, and his stomach and intestines forwarded for examination and report.

From improper packing, the matters sent were in an extreme state of decomposition and putrescence, the examination being thereby rendered complicated and very disgusting. No poison was discovered after a protracted investigation, nor was there any reason to suppose, that he had not fallen a victim to disease.

Case 8th.—Occurred at Delhi, and was examined by the Civil Surgeon, who detected the presence of arsenic; but not being willing to depend upon his own analysis, sent a portion of the fluid examined, to Calcutta, for further trial.

His judgment was found to be quite correct, and arsenious acid to have been the poison used.

Case 9th.—Two most interesting and instructive cases, which occurred at Chusan in April 1842, and in which an attempt was made by the Chinese, to poison two soldiers of Her Majesty's 55th Regiment, by means of Shamshoo, an intoxicating spirit distilled from rice. One of the soldiers died, and the other had a narrow escape.

The Shamshoo was found to contain a small quantity of an intensely bitter substance, resembling a vegetable alkaloid, which produced numbness and partial paralysis, when applied to the tongue in extremely minute quantity, and was presumed to have caused the symptoms detailed. It was most probably aconite—one of the most virulent and deadly of all known poisons.

Case 10th.—Certain substances found on the person of a suspicious character. Portions of bish, or the root of the aconitum ferox, were discovered, which is known to be a dangerous and destructive poison.

Case 11th.—Sent by Colonel McLeod, commanding the Nagpore Subsidiary Force, in which nearly three hundred persons belonging to the Artillery at Kamptee, suffered severely from bread issued to them.

In many cases, the symptoms closely resembled those produced by arsenic, and were attended with great danger; although from prompt, skilful, and active treatment, none proved fatal.

The most careful examination, repeated in every way by Mr. Robertson and myself, failed to detect any of the known poisons. It might have resulted from a diseased state of the wheat or rye from which the bread was made, or from the introduction (possibly accidental) of some narcotico-acrid vegetable poison; but as no means are yet known by which such substances may be identified when in a state of division, it is impossible to form any decided opinion on the subject.

Case 12th.—A packet of powder, which had been administered to several persons, and caused insensibility. Sent by Mr. Mytton, the Magistrate of the 24-Pergunnahs. Found to be a mixture of vegetable substances, which could not be identified in so minute a state of division, but probably containing datura seeds powdered, and perhaps aconite.

Case 13th.—A portion of bread, which had caused the death of a person who had partaken of it, and was supposed to contain arsenic. Sent from Dacca, by Mr. Taylor, Civil Surgeon. It appeared to

contain a trace of sulphuret of arsenic, to which the death was not attributed, but to some vegetable narcotico-acrid, not discoverable by analysis.

Case 14*th.*—A case of supposed poisoning,—sent by the Surgeon, 24-Pergunnahs, who forwarded the uterus, stomach, and portion of the contents of the latter, of a woman who was presumed to have been killed by the administration of some drug, given for the purpose of procuring abortion.

No chemical or pathological evidence was elicited to countenance the supposition of poisoning, or render it improbable that she had not died from disease.

Case 15*th.*—Certain substances forwarded by the Acting Sessions Judge of Bhaugulpore, through the Chief Magistrate of Calcutta. Arsenic and tabasheer were found, the former a poison, the latter inert.

Case 16*th.*—Three small packages from Mr. Turnbull, Magistrate of East Burdwan ; one of which contained datura stramonium (fragments of the seeds), the other a variety of substances, none of them poisonous.

Case 17*th.*—Portions of the intestines of three persons who were supposed to have been poisoned. They were in an extremely disgusting and offensive state of putrescence, from the improper and careless manner in which they were packed and transmitted to Calcutta. The chemical examination elicited nothing, nor was it likely to be attended with success, unless some mineral substance had been administered.

Case 18*th.*—Forwarded by Mr. Turnbull, Magistrate of East Burdwan, and consisting of a small quantity of a brown fœtid fluid, together with some dark colored substance adhering to paper.

No poison could be detected.

Case 19*th.*—A portion of some substance found in the stomach of a man supposed to have been poisoned by opium,—forwarded by the Civil Surgeon, Dacca.

No opium existed in it, but some vegetable resinous matter, which could not be identified.

Case 20th.—The stomach, its contents, and food of a man poisoned by his wife at Howrah, who acknowledged having administered a portion of a root purchased in the bazaar.

It was found to be the "*Lall chittra*" or plumbago root, a dangerous indigenous poison.

Case 21st.—A goldsmith and another person were sent to the Medical College Hospital in a state of insensibility, from some drug which had been administered to stupify them, and enable the perpetrators to plunder the property of the former. One of them died, and the Coroner sent the case for investigation.

No poison could be detected, but there was little doubt that datura, or some such substance had been administered.

Case 22nd.—A portion of substances removed from the stomach of a female, who died under suspicion of poisoning, forwarded by Mr. Chester, Joint Magistrate of Gorruckpore. It was found to contain nearly ten grains of arsenious acid.

Case 23rd.—Portions of a root, found on a person in the district jail of Kishnagur, and ascertained to be the bish, or aconitum ferox.

Case 24th.—Several substances found upon the person of a man at Allahabad, who attempted to destroy himself, to bring discredit upon his relations. Among them were found portions of aconite, and the fruit of one of the varieties of strychnos, both virulent poisons.

Case 25th.—The contents of the stomach of a man who died under circumstances of suspicion,—sent by the Magistrate of Zillah Mynpooree.

No poison discoverable.

Case 26th.—The contents of a man's stomach, who was supposed to have been poisoned at Cawnpore, together with a quantity of

chupattee, forming part of the last meal of which the deceased partook.

The latter was found to contain a very large quantity of arsenic, in the form of sulphuret.

Case 27th.—A portion of sweetmeat, which was sent by the Magistrate of the 24-Pergunnahs, on account of a similar portion having produced insensibility in a young woman, to whom it had been given.

No poison detected.

Case 28th.—Forwarded by the Surgeon, 24-Pergunnahs, requesting information as to whether certain drugs were poisonous or not.

They were found to be arsenious acid, in sufficient quantity to have poisoned several persons: two portions were found, one opaque resembling a piece of white china, the other semi-transparent and crystalline.

Case 29th.—Sent by the Officiating Magistrate of Burdwan, and consisted of a small quantity of a dark brown, extremely putrid and offensive matter in a semi-fluid state, together with particles of a grayish looking substance, which had apparently not been acted upon by the juices of the stomach. It was stated, on the confession of a woman charged with the murder of the girl to whom it was administered, to possess the property of preventing miscarriage.

No known vegetable or mineral poison could be detected by analysis, although there was no doubt that one had been administered—probably datura or aconite.

Case 30th.—Forwarded by the Civil Surgeon of Dacca, being a portion of the contents of the stomach of a person, supposed to have been poisoned. The fluid was dark-colored, fœtid, nearly of the consistence of an extract, and mixed with broken down coagula of blood.

It was found to contain a small quantity of an acrid oleaginous substance, the exact nature of which could not be ascertained.

Case 31st.—Sent by Mr. Balfour, Civil Assistant Surgeon of Bareilly, with an interesting detail of the case.

Arsenious acid was found in large quantity in the stomach. The death of the woman was attributed by those who brought in the body, to her having struck herself on the head several times with a stone or brick.

Case 32nd.—A case from the Civil Assistant Surgeon of Allahabad, forwarding for analysis, the contents of the stomach of a woman, supposed to have been poisoned. It was unaccompanied by any details, and no poison could be detected.

Case 33rd.—Two packages from the Assistant to the Governor General's Agent at Maunbhoom, supposed to contain poisons.

In the one, was found a small quantity of impure bazaar opium. The second package contained half-cooked and partially digested food, in a state of putrescence. No vegetable or mineral poison could be detected in it, and no case accompanied the matter sent for analysis.

Case 34th.—Two packages from the Surgeon to the 24-Purgunnahs.

The one contained particles of raw rice, with trace of a white looking substance, the nature of which could not be ascertained, as it presented none of the chemical characters of any known mineral or vegetable poison.

In the other parcel were found a piece of chalk, two small circular portions of common brick, and half a dozen round, black looking masses, consisting of fragments of the leaf of tobacco, with probably a small amount of opium and datura in a fine state of division.

Case 35th.—Four bottles, forwarded by the Sessions Judge of Bhaugulpore, through the Chief Magistrate of Calcutta, containing the contents of the stomach of three persons alleged to have been poisoned.

These were accompanied by an exceedingly interesting abstract of the case from the Judges, together with an outline of the post-mortem examination made by the Civil Surgeon.

Although it was distinctly admitted by the prisoners that poison had been administered, none could be detected by analysis. From

the symptoms, it was probable that aconite was the noxious agent employed.

Case 36th.—An earthen vessel and bottle from the Magistrate of Midnapore, the former containing food ejected from the stomach, and the latter the contents of that organ after the death of the man, said to have been poisoned. A report from the Civil Surgeon accompanied the communication of the Magistrate.

A trace of arsenious acid was discovered, but not in sufficient quantity to decide, positively, that the man had died from the effects of that poison, although this was probably the substance administered. There was also evidence of the presence of a salt of zinc, due, doubtless, to an emetic which had been administered upon the admission of the man into hospital.

Case 37th.—An earthen pot containing *Goor*,* with which arsenic was supposed to have been mixed,—forwarded by the Magistrate of Etawah.

It was found to contain a large quantity of sulphuret of arsenic.

Section II.

Investigations for the Military Board.

1. Several colts in the Stud at Kooruntadhee having died very suddenly, and under circumstances of suspicion, the Veterinary Surgeon recommended that a chemical examination should be instituted, to detect any poison that might be present.

The stomachs and intestines of some of them, with their contents, were, accordingly, sent to Calcutta, and examined without success—no known vegetable or mineral poison being discoverable.

2. In consequence of certain doubts which had arisen, as to the most eligible and effective composition for the manufacture of percussion caps, I was ordered to proceed to Dum-Dum, and give my opinion upon the subject to the Select Committee of Artillery Officers. I found, that the *Chlorate of Potash*, was the chief detonating ingredient then employed, and after a few experiments in which its

* The impure, dark-colored sugar of the bazaars.

corrosive effects upon the nipple of the percussion muskets, rendering them liable to become speedily useless on active service, were exhibited, I stated the superiority of the fulminate of mercury, and the reasons for which I should recommend its substitution, which were embodied in a report of the Select Committee to the Military Board, of which there is no copy in my records.

3. By order of the Governor General, and on account of the supply of percussion caps for the China expedition being exhausted, a quantity of fulminating mercury was prepared in the chemical laboratory by the Assistant to the Professor of Chemistry, at great risk to his life and health; the latter of which suffered so severely, as to arrest the further preparation of the substance, after some pounds had been furnished, sufficient to fill many thousand caps.

4. Pursuant to instructions from Government, conveyed through the Medical Board, I was directed to put myself in communication with Captain Goodwyn of the Engineers, and to report upon the safest and best mode of manufacturing fulminating mercury, which report is contained in the second part of this paper.

5. The Brigadier Commandant of Artillery, having reported to the Military Board the great destruction of fusee, bamboos, cartridges, canvass bags, &c., proposed, that *Kyan's* patent to prevent dry rot should be employed to arrest the destruction, and requested information as to the best method of preparing, and supplying the Kyanizing liquid, upon which a chemical report was furnished.

6. In addition to the above, a series of experiments were performed at the request of Captain A. H. E. Boileau, of the Bengal Engineers, upon the best means of rendering powder-bags incombustible, with a view to lessen the risk, attendant upon storing powder in the Arsenals. A private report was forwarded to Captain Boileau, for the information of Major Smith, of the Engineers.

Section III.

Analyses performed for the Salt Department.

Two hundred and twenty-two specimens of contraband Salt and Saltpetre, forwarded by the Superintendent of the Salt Chokies, 24-Pergunnahs, and the Magistrate of Allygurh, were at various times examined and reported on. These analyses are troublesome and tedious, but at

the same time so simple, that they might be taught with ease to any intelligent person employed in the Salt Department. They occupied a very disproportionate share of time and attention, compared with their value, and to the neglect of more important duties. The chief impurities contained in the salt, were sand and sulphate of soda.

Section IV.

Miscellaneous subjects.

1. A sword from the Magistrate of Burdwan, with which a murder was supposed to have been committed, and in which it was required to ascertain whether certain spots on the blade were stains of blood or rust of iron.

The examination was a very delicate and difficult one, and the result, that the spots were conjectured to be rust of iron, mixed with some albuminous and unctuous matters used for removing the same.

2. Specimens of water found entering a public drain, and forwarded by the Chief Magistrate of Calcutta, to ascertain if they contained any substances which might prove injurious to the health of the community.

They were found to contain noxious gases in sufficient quantity to asphyxiate coolies entering the drain to clean it, before means of purifying its polluted atmosphere had been adopted; but not enough to exercise any deleterious influence, upon those not immediately exposed to their effects in a confined, unventilated space.

3. Samples of the food supplied to the prisoners in the zillah jail of Allypore, to ascertain whether it was injurious to health, on being eaten the following day in a cold state.

The chemical changes which took place were carefully noted, and found to be such as would undoubtedly give rise to low forms of fever and other diseases, in those who were placed on such diet.

4. The station jail at Rajshahye, was reported by the Officiating Magistrate, Mr. T. C. Loch, to be rendered nearly uninhabitable by bugs, although a new building, and instructions were requested as to the best mode of getting rid of them. These were detailed, and a report at the end of a few months requested, to show whether the cure suggested had been effectual.

5. Two pieces of a scabbard, sent by the Magistrate of Mynpooree, to ascertain if certain spots upon them had been produced by blood.

The nature of the substance which had caused the stains, was not positively ascertained, although, they were strongly suspected to have been produced by blood.

6. A very remarkable substance, discovered by Dr. Montgomery of Singapore, called GUTTA PERCHA, and sent to the Medical Board, with specimens.

It was found to be a variety of caoutchouc, likely to become extremely valuable from its chemical and physical qualities, as well for the manufacture of surgical instruments, as for various purposes in the arts.

7. A specimen of sulphur, found near Kurrachee in Scinde, and forwarded by order of the Right Honorable the Governor General, for examination.

It was ascertained to be impure, and not likely to turn out great in value or extent of supply.

8. A specimen of saltpetre, manufactured at Tattah in Scinde, and forwarded to Government by Sir Charles Napier.

It was found to contain nearly 96 per cent. of pure nitre, and reported to be a pure and good specimen of commercial saltpetre.

9. A communication from the Magistrate of Hooghly, requesting information as to the best method of bleaching the paper manufactured by the prisoners in the jail, by means of chlorine gas.

Mr. Robertson was deputed by Government to proceed to Hooghly to report upon the manufacture generally, and to suggest such means of improvement, as he might deem advisable or necessary.

10. A small portion of the deposit of a mineral spring near Darjeeling, the water of which was stated to be used in warm baths by the natives, and the sediment itself to be employed as a remedial agent. Forwarded for analysis and report by Dr. Campbell.

It was analyzed by Mr. Robertson and found to contain in 100 parts:

Crenate and a pro-crenate of the per-oxide of iron, about		65
A carbonate,		4
Sand (Mica and Quartz from decomposed granite,)		20
Portions of Vegetable matter,	in all, about	11
Sulphuric acid,		
Magnesia,		
A trace of ammonia,		
Water and loss,		
		100

The medicinal virtues of the spring are doubtless due to the amount of iron contained in it.

The above comprises a brief abstract of the public duties of the Chemical Examiner, during the period mentioned. In addition to the cases reported in the first Section, several analyses were performed for residents of Calcutta, who supposed that attempts upon their health and lives had been made by their servants. Their apprehensions were in every instance groundless, and the cases generally of too trivial a nature to record—all the communications having been sent privately. There is no doubt, however, that much sickness is caused in this city by the impure salt, generally sold in the bazaars,—the bad quality of much of the meat consumed, especially during the prevalence of Epidemics among the cattle,—the dirty and impure state of many of the vessels used in cookery,—the improper food upon which some of the animals, killed for table use, are fed,—and other circumstances of a similar nature, which could only be prevented by the introduction of a sound and judicious system of Medical Police. The evil effects of this want of efficient control and superintendence, are most felt by the poorer classes of Europeans, who scarcely ever obtain perfectly fresh and wholesome animal food, to which is super-added, the noxious qualities of the adulterated wines and liquors consumed by them, of which I have never seen a wholesome or unadulterated muster. The arrack, beer, and other beverages, sold to soldiers and sailors, are even worse and more injurious, if possible, frequently causing fatal attacks of cholera and dysentery.

In the succeeding division of this report will be contained details of some of the most interesting cases mentioned.

On the Sickness and Mortality of the Troops at Kurnaul. By Dr. C. Finch, M.D.

Among the most remarkable circumstances in the whole province of medical statistics, are the great vicissitudes, which occur in the sanatory condition of particular localities, varying between the extremes of salubrity and distemper.

These alternate conditions of salubrity and insalubrity, occur in every quarter of the globe, and are frequently exemplified in the different stations and cantonments throughout the Indian continent.

*

Among the most remarkable instances of these variations in salubrity, there has been none more so, than the Military Station of Kurnaul, which was at one time considered the most healthy, and is now regarded as the most sickly, of the Military Stations in the Bengal Presidency. The average rate of mortality of former years, compared with that of latter, attests the general correctness of this view. In the years 1835 and 1836, when H. M. 13th Light Infantry and 31st Foot were cantoned there, the average rate of mortality was but $1\frac{1}{2}$ per cent.; while in the year 1841, it ran as high as 11 per cent. in H. M. 3rd Buffs, and 7 per cent. in the H. C. 1st European Regiment.

An inquiry into the circumstances which influence the varied states of public health, or the absence or existence of disease, is most important to determine what they are; whether they be of climatic origin and inevitable, or endemic, or of local origin and removable.

It is important to determine the nature of the influential causes on the health of particular localities, in order to point out what means may be necessary to diminish or to counteract their effects.

Should they be dependent on climate, an examination is important, to determine what precautions are necessary to oppose or to counteract their prejudicial effects.

Should they be dependent on local agency, to point out what measures are requisite to obviate them, if entirely removable, or to diminish them, if only capable of partial removal.

Such are the results to be obtained by a careful and cautious investigation into the several causes which influence the alternations in the sanatory condition of certain localities.

In illustration, I may adduce the inquiry into the causes of the sickness and mortality of the Troops at Barrackpore, which I instituted in 1840. On my return to India, and appointment to the medical charge of the 57th Regiment N. I., then stationed at Barraekpore, I was led by the great and fatal sickness, prevalent in that corps, to institute an examination into its causes. In the course of this inquiry, I ascertained that the mortal sickness, then existent, was not confined to that Regiment, but shared in by two others, the 3rd and 58th Regiments N. I.; and that the sickness was not epidemic and casual, but climatic and permanent. In the progress of my inquiry, I obtained further evidence of its being of climatic origin, and bore a relation to the length of residence of the troops at the station. It was shown

by tabular statements, taken from the hospital registers of several corps, more particularly of those of the 3rd, 57th, and 58th Regiments, that the extent of sickness and number of casualties, during the first year of their stay at Barrackpore, was not greater than the ordinary amount of sickness and deaths in the Upper Provinces, nor was it greatly increased in the second year, but that the third of their residence was the sickly and fatal year,—establishing the fact, that the native troops cantoned at Barrackpore, in lieu of becoming acclimated by length of residence, became more susceptible to the deteriorating effects of a Bengal climate. Having established this position, the remedial measure was obvious,—the curtailment of their period of service at Barrackpore, and the substitution of a biennial in lieu of a triennial relief of the troops stationed in this unhealthy cantonment. That measure was sanctioned and approved of by Government, on the recommendation of a Committee especially appointed to examine into the accuracy of the grounds of my recommendation.

The Committee, on the additional evidence it had the power to call for and obtain, was satisfied of the strength of the position I had taken up, regarding the comparative healthiness of the two first, and the unhealthiness of the third years' stay at Barrackpore, and seconded the recommendation for a biennial relief of the native regiments stationed at Barrackpore. The result of some years' experience has confirmed the expediency of the alteration, in the improved state of health, and diminution in the number of casualties among the native soldiery cantoned at Barrackpore. While these results are highly satisfactory, as confirmatory of the truth or reality of the imputed causes, which deteriorated the health of the Troops at this station, they are encouraging, as holding out inducements to undertake similar inquiries into the circumstances, which affect the state of public health in other stations and localities.

In the present paper, I purpose to enter upon the subject of the sickness and mortality, which have been prevalent for some years at Kurnaul. I am aware, that the attention of Government has been already directed to this subject, from the great sickness and mortality which took place in some of H. M. Regiments in the years 1841-42, and that a Medical and two Engineer officers have been associated, to investigate the circumstances which have had so fatal an influence on the health of the troops stationed at Kurnaul; and, but for the

events which have taken them from this field of inquiry into other fields, we might, ere now, have had the result of their united labors.

Having been furnished with some tabular statements, drawn from an authentic source and made at a great cost of time and trouble, of the state of health of the troops, quartered at Kurnaul for a series of years, I am unwilling that such valuable documents, containing such a mass of useful information, should be lost to the profession, and induced therefore to publish them.

When I state that these tabular statements were collated by Dr. John Murray, of the Horse Artillery, I offer ample guarantee for their correctness and accuracy.

From these Tables I have made certain inferences, on which I have based certain opinions relative to the causes, which have a prejudicial effect on the health of the troops at Kurnaul, and occasion the great sickness and mortality which have prevailed there. An examination of the tables, will enable any one to satisfy himself of the legitimacy of the one, and the grounds they afford for the foundation of the other.

The devastating diseases of Kurnaul have been periodic or miasmatic fevers, varying in intensity from a slight intermittent of the cold season, to the most intractable remittent fever of the rainy season; stamped with all the most characteristic symptoms of yellow fever of the West Indies, such as severe cerebral symptoms, extreme irritability of stomach, and, in some instances, yellow or bilious suffusion of the skin.

The intimate connection of the whole family of fevers, is demonstrated by their gradation from one form into another. The ephemeral, consisting of one occurrence of the cold, hot, and sweating stages, by recurrence, becomes an intermittent, and this again, by its lengthened paroxsym and contracted apyrexial period, is converted into a remittent, and this last, by indistinct remissions or apyrexial intervals, is only recognisable as a continued fever.

This ready and frequent conversion of one form of fever into another, is not more demonstrative of their intimate connection than their proceeding from one common cause,—malaria or miasma.

These varied forms of tropical fever are dependent on the intensity of the miasmatic exhalations from the earth's surface, and the intensity of these exhalations is dependent on temperature.

This is proved every year; the succession of seasons is characterized by a different form of fever, and by the prevailing endemic fevers in different climates and localities.

A reference to these Tables, shews such was the regular course of the periodic diseases which prevail at Kurnaul; intermittents are common in the early part of the year, and gradually pass into remittents during the hot and rainy seasons, and at the end of this season, again, assume their preponderance, which they retain during the continuance of the cold weather. There is not in my opinion in the whole subject of the etiology of disease, a better established fact, than the connection between marsh malaria and intermittent and remittent fevers, in their relation of cause and effect. I hold no modified faith. I acknowledge marsh malaria to be the active agent in the production of these forms of disease. In the doctrine of the causation of these forms of fever, the intermittent and remittent, I believe, that the difference is dependent upon temperature. That malarious exhalations produce, in cold or temperate countries, intermittents; while the same miasmata would, under an increased temperature, or tropical climate, occasion remittents. Mere latitude, as McCulloch has observed, is not alone a modifying agent; diminished temperature in tropical countries, produced by elevation above the earth's surface, will cause a difference in the type of fever. There are unequivocal proofs of their intimate dependency, as cause and effect, which have been accumulating for two centuries.

From Table No. 1, we learn that the months of July, August, September, and October, were the most unhealthy and fatal of the year; the ratio per cent. to strength, being respectively for these months, as follows:—

The admissions in	July,	13·16
	August,	17·14
	September,	20·60
	October,	14·13

and the per centage of deaths to strength were:—

The deaths in	July,	to strength,	0·38
	August,	,,	0·49
	September,	,,	0·64
	October,	,,	0·64

It is remarkable, that the per centage of admissions and deaths in May was very large; that of admissions being higher than that of July,

being as high as 13·73; while that of deaths being less, it is as 0·29 per cent. to strength.

This Table exhibits at a glance, the increase and fatality of those forms of fever denominated miasmatic, from their imputed source, or origin, in the four months mentioned. August, September and October, are prominently shewn to be the months in which these fevers are most prevalent: we have in these months a very large per centage to strength, and a very considerable increase in the number of these forms of disease, to that prevailing in other months.*

By a reference to the Table, it will be seen that the cases of *febres miasmaticæ* were, in the period of 13 years, the following:—

		Strength.	*Febres Miasmaticæ.*
In the 13 months of	January,	12,919	110
,,	February,	14,229	80
,,	March,	14,443	167
,,	April,	14,429	300
,,	May,	14,378	660
,,	June,	14,609	538
,,	July,	14,329	465
,,	August,	14,255	689
,,	September,	13,697	1,467
,,	October,	14,112	827
,,	November,	13,547	366
,,	December,	13,599	180

There is the same preponderance of disease observed in May, in regard to these particular forms of fever, as in the general return, or per centage, of all diseases.

There is in June a greater number of cases, and more numerous casualties from periodical fevers, than in July.

The casualties from miasmatic fevers, in the several months of the year, are shown to be in

January,	Deaths,	4	July,	Deaths,	1
February,	,,	1	August,	,,	16
March,	,,	1	September,	,,	38
April,	,,	6	October,	,,	38
May,	,,	4	November,	,,	9
June,	,,	5	December,	,,	5

* These figured statements include only European troops stationed at Kurnaul.

The greater prevalence of paroxysmal fevers in May and June, may be attributable to miasmatic exhalations, arising from irrigation of the lands in and about the cantonments of Kurnaul: and to relapses, from exposure to the sun.

From Table No. 2, we ascertain, that the most unhealthy years were those of 1829, 1838, 1839 and 1841; the ratio of sick to strength being 197·89, 200·52, 171·27, and 272·12.

The degree of prevalence of miasmatic fevers among the European troops stationed at Kurnaul, is shewn to be in each year of the thirteen, included in the period referred to, as follows:—

1829	151	Cases,	5	Deaths,
1830	77	,,	2	,,
1831	473	,,	4	,,
1832	617	,,	3	,,
1833	31	,,	3	,,
1834	111	,,	3	,,
1835	68	,,	5	,,
1836	361	,,	4	,,
1837	503	,,	4	,,
1838	603	,,	7	,,
1839	272	,,	7	,,
1840	435	,,	10	,,
1841	2,147	,,	71	,,

Paroxysmal fevers are shewn to have been most prevalent in the years 1831, 1832, 1836, 1837, 1838, 1839, 1840, 1841; but it is to be borne in recollection, that there was a considerable augmentation in the European force cantoned in Kurnaul. Prior to 1831, there were but detachments of European Horse and Foot Artillery; in that year H. M. 31st was stationed at Kurnaul, and it subsequently became the cantonment of a European Regiment. The total strength of Europeans in 1829 and 1830, was but 285 and 222; after 1831 it exceeded 1,000 men, except in 1839, when there were but 891.

In computing the comparative degree of prevalence of miasmatic diseases, we must take the ratio per cent. to strength, and not the

actual number of cases of paroxysmal fevers. By this mode of computation, we find in 1829 that the per centage to strength was 54

1830	35
1831	$39\frac{5}{12}$
1832	$51\frac{5}{12}$
1833	$2\frac{7}{12}$
1834	9·2
1835	$5\frac{2}{3}$
1836	$32\frac{1}{4}$
1837	$44\frac{2}{3}$
1838	52·9
1839	$30\frac{5}{9}$
1840	34
1841	107

By computing the extent or prevalence of miasmatic fevers in relation to the strength, we learn that they were most common in 1829, 1832, 1838, and 1841, in which years it will be seen that they exceeded 50 per cent. There is in this mode of computation a variation from the former view of looking at the abstract number, without reference to actual strength. This calculation exhibits the years 1833, 1834, and 1835, as remarkably healthy, and exempt from the occurrence of periodical fevers of every kind. These years were remarkable as dry years, or for the small quantity of rain which fell; a coincidence to be carefully borne in recollection, and to which I shall have occasion to refer in a subsequent part of this paper.

The 3rd Table exhibits the comparative annual admissions and deaths of the European and Native troops stationed at Kurnaul, for the period alluded to, from 1st January 1829, to 1st January 1842.

It points out the greater prevalence of disease in the European than in the Native troops, and their greater fatality, by the higher ratio per cent. of deaths on admissions in the former, than in the latter. On a comparison of the ratio of admissions to strength in the two classes, it appears there was no uniformity or correspondence in the numbers of the sick in the same seasons. Both classes were not equally affected in the same years.

From Table 4 we are taught, that the months of July, August, September and October, were the most unhealthy and fatal of 1841 for the European troops stationed at Kurnaul; we are further taught, that there was no inconsiderable amount of sickness in the months of April, May, and June of that year, though the casualties were not more numerous than in January and February, and did not equal in number, those which occurred in November and December 1841.

Having ascertained the nature of the diseases prevalent at Kurnaul, and the seasons and months in which they prevail most, and the years in which they have been most common, it is necessary to take a cursory view of the cantonment of Kurnaul, to assist us in tracing the occurrence of these diseases to their causes.

The cantonment of Kurnaul, is situated on a broad and nearly level plain, stretching from the canal on the east, to its western boundary, over a surface of one and a half miles.

The barracks of the European Infantry corps, together with three rows of officers' bungalows, form the east flank of cantonments, while the western is formed of jungle, and numerous stagnant pools. At the back of the barracks, or further eastward, are fields of rice, *jawarree* and *bajra,* crops which require irrigation; and running in a south-easterly direction, is the canal supposed to be a prolific source of sickness: its banks on each side, are lined with sedges and much luxuriant vegetation, which is stated to be continually passing into a state of decomposition. On the left bank, or opposite side of the canal, there is a large extent of swamp or oozy ground, covered with the like rank vegetation. To the north-east of cantonment is an extensive jheel, extending one and a half miles northwards.

Between the east and west flanks, lie the parade grounds,—as has been said, almost a level surface: on the north of this plain and near the centre, is the church, built on the only rising piece of ground: to the south of this plain, are the barracks and lines of the troops: to the right, the lines of a corps of Native Infantry, the barracks of the Foot Artillery, then the lines of a second corps of Native Infantry: on their left, lines for two regiments of Native Cavalry: the European Dragoons are in the extreme left, and in their rear, the Horse Artillery. To the north of the Horse Artillery and

Dragoon stables, is their parade ground. To the west, are the jungle, and pools, already mentioned.

The soil is argillaceous and retentive of moisture. To this, and the absence of drainage, is to be attributed the conversion of the parade ground, during the rains, into a swamp or jheel of water.

The close alliance of the several forms of intermittent and remittent fevers, from their ready gradation into each other, is not better known, than their unity of causation, viz.,—terrestrial, or miasmatic exhalations.

A reference to the plan of Kurnaul will shew, how abundant are the sources of miasmatic exhalations, within and without the limits of that cantonment. To the north-east, is a large jheel about a mile and a half from cantonments; south of that, or eastward of, and in the immediate vicinity of the officers' bungalows and barracks of the European Infantry, are the oozy banks of the canal, over which the water finds its way into the plain between the canal and the residences of both officers and men. A remark of Surgeon W. Mitchelson, points out how very prejudicial this must be to the health of the inmates, and the close connection between the prevailing sickness, and paludal exhalations, arising in the vicinity of the canal:—he says, that of the officers of the H. C. 1st European Regiment living in the bungalows in that locality, there was scarce one escaped an attack of the prevalent sickness.

Further south and due east of the parade ground, there are several fields under cultivation, close to, and almost within the limits of the cantonments, in which are grown crops of rice, jawarree and bajra, all of which require and are subjected to frequent irrigation from the canal; these undisputedly have a prejudical effect on the health, and may account for the occurrence of intermittent and remittent fevers, during the hot weather.

The whole range of the westward boundary, are the remains of jungle, interspersed with jheels and tanks, which afford, as ample a source for the origin of these miasmatic fevers, as the canal on the east flank.

But it is not jheels or swamps alone, which afford origin to miasmatic exhalations; large bodies of surface water exposed to the solar rays in a tropical climate, are undoubtedly very fertile sources of

miasma, and generate fevers of every type. We coincide in opinion with Dr. Ranken, who has laid it down as an axiom in regard to the production of these fevers, that vegetable substances in a state of decomposition and solution in water, become prejudicial to health, and capable of producing fevers. Water cannot exist on the surface of the earth, in this climate, without admixture with vegetable matter, which, by the instrumentality of heat, is decomposed and converted into a morbific agent. Dr. Ranken, also assumes as an axiom, that wherever a body of water, flowing or stagnant, appears on the surface of the ground in India, it is impregnated with vegetable and animal matter, which the influence of the sun will convert into malaria.

Receiving this dogma, the whole parade ground lying between the canal on the east, and the jungle on the west, from its level surface and clayey bed, on which water remains for days, and in the rainy season for weeks, becomes one continuous source of miasmatic effluvia; while the ground to the south-west and to the north of the barracks of the 3rd Dragoons and Horse Artillery, becomes a swamp during the greater part of the rains, and a more dangerous vicinage than the marshy banks of the canal; for the corps above-mentioned suffered in a greater degree than the European Infantry, and the cases were more malignant and intractable, than those of the European Foot Regiments; a fact which militates greatly against the opinion, that the canal is the chief, or sole cause of the insalubrity of the station of Kurnaul.

Another fact before-mentioned and exhibited by the tabular statement of the healthiness of the years 1835-6, and their immunity, or freedom, from paroxysmal fevers, together with the coincidence of these years, being remarkably dry ones, proves that the surface water on the parade, is no mean agent in the production of malaria and of malarious fevers. The absence of rain, or its diminished quantity, preventing the generation of marsh effluvia during these years, accounts for the absence of fever, and the freedom from sickness of the soldiery.

But there are yet other sources of malaria, independent of those inherent in the soil and locality, which have been so destructive at Kurnaul; these are artificial ones originating in the cultivation of rice, jawarree and bajra, crops all requiring irrigation, which is permitted around cantonments, and it is said, even within their limits. Irri-

gation in the vicinity of cantonments, is permitted, if not encouraged, by the civil authorities, though it has often been decried and condemned by the presiding medical authority, as destructive to the health of the military; but the interests of the revenue have been considered paramount to the welfare of the troops, and irrigation is yet allowed. It is well known, that a wealthy Zemindar purchases up every biggah of ground in the immediate neighbourhood of cantonments, for the purpose of rice cultivation.

The next unhealthy part of the cantonment of Kurnaul, is to the eastward of the parade ground, and is indebted for its insalubrity, to the exhalation from the ground in front, and to the west of the European Infantry barracks. Nothing has been done to render this part of the cantonments more healthy, by cutting drains or water-courses, though it is affirmed on high authority, that there is a considerable fall from the centre of the exercise ground, to the right bank of the canal, as much, it is said, as six or seven feet, within 1,000 yards; and offering every encouragement and prospect of completely draining this part of cantonments. It has been recommended to establish a large, broad, and superficial drain, very gently sloped off on each side, gradually deepening it towards the canal; it would rapidly convey away the rain from the parade ground, and discharge it into this reservoir. If the station of Kurnaul is to be the residence of 3, or 4,000 European troops, it is the duty of Government, by every means in its power, by an effectual system of drainage, to render it salubrious, and do all that is possible to restore its former character and reputation, as a sanatory station for its military occupants.

I am decidedly of opinion, that the causes of the sickness and mortality of Kurnaul, are to be referred to the soil and nature of the cantonment ground, and the irregular falls of rain during the rainy season.

The soil is argillaceous, or retentive of moisture, so much so, that the rain remains for weeks and days on the surface unabsorbed, after a heavy fall of rain, which of itself is a sufficient cause of disease.

The present Director General of the Medical Department of the British Army, states it to be his opinion, that simple moisture is noxious to the health of the soldiery, and adduces in proof, the situation of the 61st Regiment in the Pharos [see his Medical Sketches of the expedition to Egypt from India, p. 83.]

I have mentioned the boundaries of the parade ground or cantonments. It is on all sides surrounded with swamps,—on the east along the banks of the canal, and on the west by jungle as well as jheels. In the north-east and in front, there is a large jheel, and to the south, about a mile in rear of the station, there is a great extent of marshy ground. From these several localities, there is little doubt malarious exhalations arise, which are amongst the most active agents in producing the severe sickness among the troops. In confirmation of this observation, we find that in the site of the corps, where these effluvia made themselves so sensible as to cause the men to endeavour to exclude them at night, by shutting the jhamps, there the sickness was most prevalent and the cases most severe. I allude to the troops of the Horse Artillery and H. M. 3rd Dragoons.

It is an established axiom in medical etiology, as I have said, that the decomposition of vegetable matter by the instrumentality of moisture and heat, gives out exhalations which are prejudicial and often destructive to human life. The exhalations from the surface of the parade, and the effluvia from the swamps surrounding Kurnaul, are the active agents in the production of the diseases which have prevailed there and proved so destructive to the European corps cantoned at that station.

The greater and more fatal prevalence of the sickness in some years, than in others, is ascribable to the heavier and irregular falls of rain, during the wet-season, by which the parades and neighbouring grounds are flooded, and in the long and unusual intervals of rain, are exposed to the scorching rays of a tropical sun shining through a clear atmosphere. These abundant sources of malaria will readily account for the occasional aggravation of sickness, in seasons marked by this irregular distribution of rain.

Such are the opinions of a Committee of Medical Officers, assembled to inquire into, and report on the cause of the sickness, which existed among the troops at Kurnaul, in 1841.

The Committee consisted of Superintending Surgeon W. Panton, President.

Surgeons J. Thomson, Horse Artillery; W. Darby, 1st Light Cavalry; J. Henderson, M. D., H. M. 3rd Dragoons; A. Macqueen, M. D., H. M. 3rd Buffs.

The Committee after a careful inquiry into the nature and extent of the sickness prevalent in the station and surrounding country,

state,—"Since the middle of August, fevers of the remittent and intermittent types, have been unusually prevalent among the Europeans corps and Native Infantry, and latterly, the Cavalry, the camp followers, and, generally, the inhabitants in the neighbourhood."

"That the cantonment, being situated on an uninterrupted level plain of great extent and of clayey soil, the water is not readily absorbed, and lies on many parts of the lines and parade grounds in extensive sheets of the depth of several inches, for some days following a fall of rain; such surfaces, acted on by the intense heat of the sun, generate malaria in great abundance over the whole extent of the cantonment and its vicinity; and to this cause, the Committee ascribe the prevalence of fever in the present season."

The present Surgeon General W. Panton and lately Superintending Surgeon of the Sirhind Division, in his Annual Report on the Hospitals of European and Native troops in the Sirhind Division, for 1842, writes to the Medical Board,—"That the state of health at Kurnaul, during the past year, has been unfavorable, from causes similar to those which were formerly reported to have operated injuriously on the troops in the preceding year."

"The hot season continued long and most oppressive, interrupted only by occasional showers, until the middle of July, and again till the end of August, when heavy falls of rain occurred, and flooded the cantonment for some days."

"In July, fevers intermittent and remittent began to be prevalent, and as the season advanced, during August and September, the number of remittents gradually, but steadily, increased, until the middle of October, when these decreased, and the intermittent type prevailed afterwards in greater proportion."

"The soil on which the cantonments are situated being argillaceous, retains water on the surface long, and when allowed so to remain exposed to intense solar heat, malaria will soon be generated."

Dr. Panton also refers the deterioration of the health of the troops stationed at Kurnaul of late years, to the increase and extension of rice cultivation to the very boundaries of cantonments.

Dr. McGregor, who has given much attention to this subject in reference to the sickness prevalent at Kurnaul in the succeeding year 1843, as well as to that of the previous two years, states,—"the cause of the great sickness at Kurnaul, during the past three years,

was the unusual nature of the rainy season, acting on a soil which is slow in absorbing moisture."

"When rain falls in moderate quantities, and at short intervals, Kurnaul is comparatively healthy, but if to a heavy fall of rain, a long drought succeeds, malaria is generated, and fevers prevail. The two years of 1841 and 1842 closely resembled each other, and from the first fall of rain in the latter part of June, little or none fell until the 21st July, when a heavy fall took place, succeeded by a long series of dry sultry days. Had such seasons occurred at Loodiana, the deleterious effects would have been prevented by the rapid absorption caused by the nature of the soil; and even at Umballah, heavy falls of rain are not necessarily succeeded by the deadly fevers witnessed at Kurnaul."

Dr. McGregor repudiates the very idea of including among the causes, prejudical to the sanatory condition of Kurnaul, the vicinity or presence of the canal; and, I think, satisfactorily refutes the opinion which has been often advanced of its being the chief source of the great sickness which formerly, as well as of late years, prevailed at Kurnaul. His words are,—"as to stagnant water, there exists on the east of cantonments a canal, which has been adduced as the cause of the unusual sickness, which has prevailed at Kurnaul for the last three years. When the 1st European Light Infantry occupied the lines in its vicinity, it was not easy to persuade people that other causes existed, without having recourse to the canal, perfectly sufficient in themselves to account for the unusual sickness; and the circumstance of the neighbouring district, where there was no canal, being equally sickly, was sufficient to establish this point. In 1843, the new cantonments were vacated, and the European troops cantoned at a distance from the decided source of fever; it was found, that instead of being less, the sickness was increased; and therefore, though the canal might serve to increase the sickness, it could not be alone blamed for giving rise to it: besides, in the year 1823, or twenty years before, the sickness and mortality at Kurnaul exceeded any thing that has been witnessed since; there was at that time, I believe, but one company of European Foot Artillery stationed there, and yet the deaths amounted to a fourth of the whole company, or twenty-five per cent., a result which has never

been observed since, not even among the Buffs in 1841. Again in 1829, a European troop of Horse Artillery had half its number in hospital from fever, in September, and the mortality was great; yet in the two succeeding years, the health of the troops was comparatively good, and H. M. 31st Regt., which first occupied the lines about this period, continued healthy during its stay at Kurnaul. Now, during the whole of this period of twenty years, the canal was present, and yet the baneful effects of it were only felt at intervals of five or six years! In 1841, the Buffs suffered severely from fever at Kurnaul, and the mortality was very great; to account for this sickness, the canal was brought forward! The succeeding year 1842, was equally sickly to the 1st European Light Infantry, and the canal again blamed. The cantonments near it were abandoned, and for the first time, during twenty years, the canal could not be laid hold of to account for the sickness, though the latter had exceeded that of the two former seasons."

I have mentioned, as militating strongly against the opinion that the canal is chargeable with the production of the febrile diseases which prevailed and decimated the troops in 1841, that the Horse Artillery and H. M. 3rd Dragoons, the corps that were located on the left flank of cantonments, or at the greatest distance from the canal, were even more, or as sickly, as the H. C. 1st European, or H. M. 3rd Buffs, who occupied barracks in the right flank of cantonments, and in the immediate vicinity of the canal—and that the cases in the hospitals of the Horse Artillery, and H. M. 3rd Dragoons, were more severe and intractable, than those in the hospitals of the Infantry regiments above-mentioned. These circumstances are subversive of the opinion, that the cause of the sickness and mortality of Kurnaul is mainly attributable to the presence of the canal.

Remedial Measures.—From this view of the causes of the sickness of the soldiery at Kurnaul, it is evident that some of them are capable of remedy, and others irremediable. I coincide with Dr. McGregor, who has alluded in almost every number of the Quarterly Medical and Surgical Journal, to the subject of the cause of the sickness and mortality at Kurnaul of late years, in the opinion he has given, —that, as long as Kurnaul continues a Military station, it will, most probably, never be free from endemic fevers, with such apparent and

obvious causes of diseases on every side and around it, with such insufficient drainage: but much may be done to diminish the sources of paludal exhalations.

It has been proposed at a cost of 50,000 Rs., to raise the right bank of the canal, the water from which occasionally rises above it and floods the ground and fields to the east and south-east of cantonments; this might, provided irrigation was prevented, diminish one cause of marsh miasma, and be operative in rendering this portion of cantonments more healthy.

Among the most apparent causes of sickness, is irrigation within the immediate vicinity of the residences of the officers and barracks of the troops, this is remediable; all irrigation should at once be put a stop to within a mile of cantonments, and a general rule should be enforced, not only in reference to this, but every other station occupied by the Military; and the suicidal system abandoned, which obtains a revenue, at the sacrifice of the health and lives of the soldiery by whom the fields were won and are retained.

There have been few greater improvements introduced of late in the culture of the lands, than the attention which has been shewn to drainage; happily, it is not inconsistent with health, but the reverse, the more effectual the drainage effected, the more healthy have localities become in every portion of the globe; and it is beyond question, that whole districts, scarcely now habitable, would become populous, were they subjected to an efficient drainage. Kurnaul has, but an imperfect drainage. The capabilities of an effectual drainage is asserted on the knowledge of officers long resident at the station, and familiar with its details and localities.

It is perhaps incorrect to describe the plain on which the cantonments are built as a dead level, and decidedly incorrect to state, that it is lower than the surrounding country. The plain of Kurnaul has a gentle declivity from north to south, which has been taken advantage of in the endeavours hitherto ineffectually made to drain the parade, by two extensive water-courses, or ditches, cut the whole length of the parade, the one to the north, the other to the south of the parade ground and in front of the Native Infantry lines; the northern channel, receives the water flowing from the north and prevents it inundating the exercise ground, while the large water-course or drain to the south, and in front of the lines, carries off the rain which flows

into it off the parade, and preserves the Native Cavalry and Infantry lines from being swamped or flooded after heavy falls of rain. In the construction of this water-course, there was a very obvious oversight committed, in throwing up the earth on both sides so as to form embankments, and effectually prevent the water from running off the parade, and in this manner, to render nugatory its existence as a drain: this error has been pointed out and rectified by the removal of the earth thrown up to the northern or parade side, and it is now an efficient channel for receiving, and conveying away the water which flows southwards from the parade ground to a tank or jheel to the westward. The declivity of the whole country is so easy and gentle, that a sufficient fall is not nearer than a mile and a half south of the cantonments. It has been recommended as part of a plan for the effectual drainage of Kurnaul, that a broad and deep channel be cut from the western extremity of the ditch in front of the lines and south of the parade to this distance, so as to carry off the water which remains on the parade ground to the north and in front of the Dragoon and Horse Artillery stables; a most desirable object, as this is one of the most prolific sources of the worst cases of remittent fever, and so concentrated is the miasma at this particular locality, that it becomes disagreeably perceptible to the senses; the men in their lines were in the habit of shutting down the jhamps at nightfall, to exclude the malaria, which they compared to a fishy stench. Can it be surprising, that the European Dragoons and Horse Artillerymen should suffer, and become victims to a pestilence which made itself so obvious to the senses? It would be surprising had they escaped.

The principal measure of prevention which suggests itself on a supposition, that the chief cause of the sickness and mortality of the troops at Kurnaul, has been shewn to be the large body of surface water which remains unabsorbed for so many days after heavy falls of rain,—is improved drainage.

The facility of improving the drainage of the cantonments of Kurnaul has been pointed out.

From the north of the parade ground, there is, though not a very considerable slope or fall towards the south, but sufficient to carry off the rain in this direction, and made evident by the ground around, and to the south of the barracks of the 1st European

Light Infantry, being flooded from the water pouring on them from the ground to the north.

There is a wide extent of ground between the European Infantry lines and Hospital, upwards of 1,000 yards in breadth, and southwards to the Church, where water flowing from the north, lies for many days and weeks exposed to intense solar heat, and which, by a broad and sloping water-course cut from west to east, gradually deepening as it approaches its termination in the canal, is capable of thoroughly draining, and thus drying up, or removing, one of the most obvious and productive sources of malaria on the east flank of cantonments.

These measures would effectually remove the most obvious and productive sources of malaria, and might contribute in a great degree, to restore to Kurnaul its former high character, as one of the most healthy stations in this Presidency.

We would refer to the station of Dinapore in proof of the beneficial effects of an efficient system of drainage. The cantonment of Dinapore is situated in a declivity, sloping from the river to a nullah in the rear of the barracks into which the drains of the cantonment empty themselves, and to the admirable construction of these drains, which empty themselves with all the velocity of sluices, the dryness and cleanness of the Station is referrible.

I agree in opinion with the present Surgeon General Dr. Panton, that much might be done to restore the salubrity of Kurnaul in ordinary years, and in seasons during which there is a regular distribution of rain, and in seasons characterized by heavy falls of rain succeeded by long intervals of dry and oppressive weather, such as those of 1823, 1829, 1841, 1842, and 1843, it is probable that the measures proposed, comprising an efficient system of drainage, would suffice to prevent a recurrence of the severe paroxysmal fevers, which have occurred there in the years above indicated. As it is beyond the power of human foresight to foresee the recurrence of similar seasons these measures must be taken, should Government cancel its resolution of abandoning the station. The dismantling and abandoning the station of Kurnaul, as a residence for European troops, must entail on the Government a loss, estimated at the most moderate computation of three lacks of rupees. The sacrifice of private property, also consequent on this step, may be estimated at a similar amount, for which no compensation is allowed.

TABLE No. I.

Abstract of Comprehensive Table of Monthly Admissions and Deaths in the European Troops Stationed at Kurnaul, from 1st January 1829 to 31st December 1841. From the records of the Superintending Surgeon's Office. By permission.

Months.	Total Strength.		Apoplexia.	Delirium Tremens.	Cholera.	Dysenteria.	Febris. Continua.	Febris. Miasmatica.	Splenitis.	Hepatitis.	Rheumatism.	Venereal.	Ulcers.	Thoracis Morbi.	Ophthalmia.	Vulnera.	Alii Morbi.	Total.	Ratio per cent. to Strength.	Deaths to Admissions.	Average Strength.
January, ..	12,919	Admitted,	..	24	1	106	34	110	2	46	65	148	25	61	57	87	281	1,047	8·11	2·77	993
		Died, ..	..	2	..	8	..	4	..	5	..	..	..	3	..	1	6	29	0·22		
February,	14.229	Admitted,	1	17	4	85	36	80	1	32	49	150	21	44	63	90	277	950	6·68	2·10	1,094
		Died, ...	1	..	..	3	2	1	..	5	..	..	..	2	..	..	6	20	0·14		
March, ..	14,443	Admitted,	..	27	5	115	87	167	3	56	57	212	28	42	65	97	375	1,335	9.24	1·12	1,111
		Died, ...	..	..	..	5	..	1	..	1	..	..	..	2	..	..	6	15	0·10		
April, ..	14,429	Admitted,	3	18	26	204	109	300	5	72	63	205	36	35	74	129	428	1,706	11·74	1·70	1,110
		Died, ...	1	1	..	8	..	6	..	2	..	..	1	4	..	..	6	29	0·20		
May, ..	14,378	Admitted,	..	28	22	194	40	660	7	72	76	198	31	29	84	102	422	1,975	13·73	2·12	1,106
		Died, ...	1	1	5	18	1	4	..	2	1	1	..	2	..	2	4	42	0·29		
June, ..	14,609	Admitted,	2	23	14	154	101	538	2	55	59	164	42	34	58	104	431	1,781	12·20	1·40	1,124
		Died, ...	1	1	2	7	1	5	..	3	..	..	..	2	..	..	3	25	0·17		
July, ..	14.329	Admitted,	2	33	52	196	140	405	8	84	68	174	38	36	42	76	472	1,886	13·16	2·89	1,102
		Died, ...	2	1	19	7	4	1	..	8	1	..	..	3	..	1	7	54	0·38		
August, ..	14,255	Admitted,	1	25	94	318	312	689	10	71	45	161	41	42	60	80	496	2,445	17·14	2·90	1,097
		Died, ...	..	3	21	14	4	16	..	6	1	..	..	1	..	..	5	71	0·49		
September	13,697	Admitted,	2	16	38	237	262	1,457	3	43	49	116	37	40	69	82	358	2,819	20·60	3·12	1,053
		Died, ...	1	1	10	19	6	38	..	3	..	1	..	2	..	..	7	88	0·64		
October, ..	14,112	Admitted,	1	17	12	244	142	827	8	51	62	98	28	47	47	83	329	1,996	14·13	4·55	1,086
		Died, ...	..	..	5	18	6	38	..	9	..	..	1	7	..	1	6	91	0·64		
November,	13,547	Admitted,	3	15	6	216	34	366	7	58	61	156	20	40	36	98	306	1,452	10·72	3·09	1,042
		Died, ...	2	..	..	19	2	9	..	5	1	..	..	3	..	..	4	45	0·33		
December,	13,599	Admitted,	1	38	8	165	39	180	9	70	78	176	23	56	34	126	313	1,316	9·67	2·88	1,046
		Died, ...	1	1	1	18	1	5	..	4	..	..	..	1	..	..	6	38	0·28		
Average Total Strength.	14,052	Admitted,	16	291	282	2,234	1,336	5,849	65	710	732	1,957	370	506	689	1,154	4,518	20,709	147·38	2·64	1,081
		Died, ...	10	11	63	144	27	128	..	53	4	2	2	32	..	5	66	547	3·89		
		Deaths to Admissions	62·50	4·43	22·34	6·44	2·02	2·18	..	7·46	0·54	0·10	0·54	6·32	..	0·43	1·46	2·64			

KURNAUL: 1st January 1829, to 31st December 1841.

JOHN MURRAY, *Assistant Surgeon, Horse Artillery.*

TABLE No. I.—*(Continued.)*

Abstract of Comprehensive Table of Monthly Admissions and Deaths in the European Troops Stationed at Kurnaul, for each Month from 1*st January* 1829, *to* 31*st December* 1841. *From the Records in the Superintending Surgeon's Office.—By permission.*

Months.	Years.	1829.	1830.	1831.	1832.	1833.	1834.	1835.	1836.	1837.	1838.	1839.	1840.	1841.	Total.	Annual Average.
	Average Strength, ..	285	222	1,194	1,203	1,196	1,169	1,211	1,125	1,131	1,143	891	1,285	1,997	14,052	10·81
January, ..	Admitted, ..	25	28	86	74	38	35	43	59	112	123	72	78	274	1,047	80·54
	Died, ...	..	..	2	2	2	3	3	2	3	1	6	1	4	29	2·23
February, ..	Admitted, ..	26	19	112	65	56	34	25	57	73	102	70	94	217	950	73·08
	Died, ...	..	..	3	3	1	2	..	1	2	2	1	1	4	20	1·54
March, ..	Admitted, ..	35	36	114	86	54	48	114	98	104	132	77	131	306	1,335	102·70
	Died, ...	..	..	1	3	1	..	..	1	2	1	2	2	2	15	1·15
April, ..	Admitted, ..	42	24	144	117	82	71	64	101	145	179	142	187	409	1,707	131·31
	Died, ...	..	..	3	2	2	3	..	5	..	1	4	5	4	29	2·23
May, ..	Admitted, ..	70	25	151	396	68	67	67	128	157	166	126	153	401	1,975	151·92
	Died, ...	1	2	6	2	3	7	1	..	4	4	2	6	4	42	3·23
June, ..	Admitted, .	51	29	165	256	73	66	63	114	158	163	148	128	367	1,781	137·00
	Died, ...	..	1	6	1	3	2	1	1	1	1	2	2	4	25	1·92
July, ..	Admitted, ..	51	27	157	151	96	79	73	119	165	224	130	142	472	1,886	145·08
	Died, ...	..	..	2	4	8	2	2	..	2	19	1	4	10	54	4·15
August, ..	Admitted, ..	50	31	180	145	108	81	92	208	166	413	152	165	654	2,445	188·08
	Died, ...	..	..	1	4	6	4	3	3	1	26	8	4	11	71	5·46
September, ..	Admitted, ..	81	33	178	112	72	97	89	197	196	350	232	189	993	2,819	216·84
	Died, ...	4	..	2	3	5	3	3	4	2	10	13	4	35	88	6·46
October, ..	Admitted, ..	50	39	111	82	67	45	53	156	206	199	124	252	612	1,996	153·54
	Died, ...	3	2	3	5	..	4	4	2	8	6	5	9	40	91	7·00
November, ..	Admitted, ..	39	11	97	98	61	42	55	116	160	143	65	194	371	1,452	111·69
	Died, ...	1	..	3	7	..	3	1	..	..	5	1	3	21	45	3·46
December, ..	Admitted, ..	44	9	63	56	38	37	40	110	138	98	88	234	361	1,316	101·23
	Died, ...	1	..	1	5	2	2	1	..	..	7	1	3	15	38	2·92
Total, ..	Admitted, ..	564	311	1,558	1,638	813	702	778	1,463	1,780	2,292	1,426	1,947	5,437	20,709	1593·00
	Died, ...	10	5	33	41	33	35	19	19	25	83	46	44	154	547	42·00
Ratio per cent. to Strength.	Admitted, ..	197·89	140·09	130·31	236·15	67·97	60·05	64·24	130·04	157·38	200·52	171·27	151·51	272·12	147·38	..
	Died, ...	3·50	2·50	2·75	2·40	2·84	2·99	1·56	1·68	2·29	7·26	5·05	3·42	7·71	3·89	..

TABLE No. II.

Abstract of Comprehensive Table of Admissions and Deaths of the European Troops Stationed at Kurnaul, from 1st January 1829, to the 31st December 1841. From the Records in the Superintending Surgeon's Office.—By permission.

Years.	Corps.	Strength.		Apoplexia.	Delirium Tremens.	Cholera.	Dysenteria.	Febris. Continua.	Febris. Miasmatica.	Splenitis.	Hepatitis.	Rheumatism.	Venerea.	Ulcers.	Thoriacis Morbi.	Ophthalmia.	Vulnera, &c.	Alii Morbi.	Total.	Ratio per cent. to Strength.	Deaths to Admissions.
1829.	H. A. $\frac{11}{12}$ .... 94 F. A. 191	285	Admitted, Died, ...	.. ..	.. ..	5 1	82 2	.. ..	151 5	.. ..	10 1	23 ..	68 1	16 ..	1 ..	8 ..	46 ..	154 ..	564 10	197·89 3·50	1·77
1830.	H. A. $\frac{10}{12}$ .... 61 F. A. $\frac{10}{12}$ .... 158 Depôt, ... 3	222	Admitted, Died, ...	.. ..	.. ..	.. ..	30 1	.. ..	77 2	.. ..	2 ..	10 ..	46 ..	10 1	.. ..	8 ..	33 ..	95 1	311 5	140·09 2·50	1·60
1831.	H. A. $\frac{9}{12}$ .... 81 F. A. $\frac{8}{12}$ .... 142 H. M's. 31st, .. 971	1,194	Admitted, Died, ...	.. ..	.. ..	20 ..	179 20	.. ..	473 4	.. ..	39 5	35 ..	211 ..	17 ..	41 1	250 ..	86 1	217 2	1,558 33	130 31 2·76	2·11
1832.	H. A. $\frac{9}{12}$...... 87 F. A. $\frac{10}{12}$...... 153 H. M's. 31st, .. 964	1,203	Admitted, Died, ...	2 1	6 ..	34 3	197 11	124 4	617 3	2 ..	53 10	40 ..	108 ..	45 ..	41 4	73 ..	108 ..	188 5	1,638 41	136·15 3·40	2·50
1833.	H. A. $\frac{11}{12}$...... 107 F. A. $\frac{11}{12}$...... 184 H. M's. 31st, .. 905	1,196	Admitted, Died, ...	2 2	15 1	16 2	98 10	96 2	31 3	.. ..	61 5	25 ..	75 ..	15 1	34 1	57 ..	65 1	223 5	813 33	67·97 2·84	4·06
1834.	H. A. $\frac{11}{12}$...... 116 F. A. $\frac{9}{12}$...... 159 H. M's. 31st, .. 894	1,169	Admitted, Died, ...	3 3	12 1	23 4	84 4	31 2	111 3	.. ..	33 8	37 ..	66 ..	12 ..	22 4	39 ..	69 2	160 4	702 35	60·05 2·99	4·98

TABLE No. II.—*(Continued.)*

Abstract of Comprehensive Table of Admissions and Deaths of the European Troops Stationed at Kurnaul, from 1st January 1829, to the 31st December 1841.—From the Records in the Superintending Surgeon's Office.—By permission.

Years.	Corps.	Strength.		Apoplexia.	Delirium Tremens.	Cholera.	Dysenteria.	Febris. Continua.	Febris. Miasmatica.	Splenitis.	Hepatitis.	Rheumatism.	Venerea.	Ulcers.	Thoracis Morbi.	Ophthalmia.	Vulnera, &c.	Alii Morbi.	Total.	Ratio per cent. to Strength.	Deaths to Admissions.
1835.	H. A. .... 114 F. A. .... 210 H. M's. 31st, .. 887	1,211	Admitted,	..	16	24	73	79	68	3	40	32	23	15	17	36	66	286	778	64·24	2·47
			Died, ...	..	..	1	4	..	5	..	2	1	..	..	2	..	..	4	19	1·56	
1836.	H. A. .... 113 F. A. .... 200 H. M's. 13th, .. 812	1,125	Admitted,	1	31	6	103	31	361	..	30	51	182	26	30	23	85	503	1,463	130·04	1·29
			Died, ...	1	2	..	3	..	4	..	1	..	..	..	2	..	..	6	19	1·68	
1837.	H. A. .... 109 F. A. .... 211 H. M's. 13th, .. 811	1,131	Admitted,	2	38	15	114	..	503	2	64	93	174	42	40	23	77	593	1,780	157·38	1·40
			Died, ...	..	1	4	6	..	4	..	1	1	..	..	2	..	1	5	25	2.29	
1838.	H. A. .... 129 F. A. $\frac{10}{12}$ .... 189 H. M's. 13th, $\frac{10}{12}$ 688 H. M's. 31st, .. 114 Depôt $\frac{2}{12}$ 23	1,143	Admitted,	2	50	91	322	193	603	2	70	111	143	33	59	44	93	476	2,292	200·52	3·62
			Died, ...	2	1	39	13	6	7	..	3	1	..	..	2	..	..	9	83	7·26	
1839.	H. A. ...... 129 F. A. $\frac{11}{12}$ .... 189 H. M's. 44th, $\frac{10}{12}$ 493 Depôt, ... 80	891	Admitted,	1	37	21	194	256	272	10	41	53	147	61	17	14	46	256	1,426	171·27	3·22
			Died, ...	..	..	8	17	5	7	..	4	1	..	..	1	..	..	3	46	5·05	

TABLE No. II.—*(Continued.)*

Abstract of Comprehensive Table of Admissions and Deaths of the European Troops Stationed at Kurnaul, from 1st January 1829, to the 31st December 1841. From the records in the Superintending Surgeon's Office. By permission.

Years.	Corps.	Strength.		Apoplexia.	Delirium Tremens.	Cholera.	Dysenteria.	Febris. Continua.	Febris. Miasmatica.	Splenitis.	Hepatitis.	Rheumatism.	Venerea,	Ulcers.	Thoracis Morbi.	Ophthalmia.	Vulnera, &c.	Alii Morbi.	Total.	Ratio per cent. to Strength.	Deaths to Admissions.
1840.	H. A. ...... 119 F. A. ...... 99 H. M's. 44th, $\frac{10}{12}$ 601 Do. 3rd Buffs $\frac{2}{12}$ 134 Do. Do. $\frac{3}{12}$.. 144 Depôt, ... 101	1,285	Admitted,	3	30	4	196	245	435	6	60	51	191	78	37	41	136	434	1,947	151·51	2·26
			Died, ...	1	1	1	10	6	10	..	6	..	1	..	..	..	..	8	44	3·42	
1841.	H. A. .... 113 F. A. $\frac{10}{12}$...... 766 H.M's. 3d Drgs. 530 H.M's. 3d Buffs 764 1st E. Regt. .. 514	19,976	Admitted,	..	56	23	562	281	2,147	40	207	171	533	..	167	73	244	933	5,437	272·12	2·83
			Died, ...	..	4	..	43	2	71	..	7	..	..	..	13	..	..	14	154	7·71	
	Total 13 years,	14,052	Admitted,	16	291	282	2,234	1,336	5,849	65	710	732	1,957	370	506	689	1,154	4,518	20,709	147·38	2·64
			Died, ...	10	11	63	144	27	128	..	53	4	2	2	32	..	5	66	547	3·89	
	Ratio per cent. to Strength, ...	....	Admitted,	0·11	2·07	2·00	15·89	9·52	41·62	0·46	5·05	5·21	13·92	2·63	3·59	4·90	8·21	32·15	147·38		
			Died, ...	0·07	0·08	0·44	1·02	0·19	0·91	..	0·37	0·03	0·01	0·01	0·22	..	0·04	0·47	3·89		

JOHN MURRAY, M. D.
Assistant Surgeon, Horse Artillery.

TABLE No. II.—*(Continued.)*

Memorandum from Abstract of Comprehensive.

Greatest Mortality.	Years.	Number of Deaths.	Deaths to Strength.	Deaths to Admissions.	Least Mortality.	Years.	Number of Deaths.	Deaths to Strength.	Deaths to Admissions.
From Cholera, ..	1838	39	3·41	43·95	Cholera, ...	1830-1-6 1841	0	0	0
,, Dysenteria,	1841	43	2·15	7·65	Dysenteria, ...	1830	1	0·45	3·33
,, Febris, ...	1841	73	3·66	3·13	Febris, ...	1836	4	0·35	1·11
,, Hepatitis, ..	1834	8	0·68	24·24	Hepatitis, ...	1830	0	0	0
,, Thoracis Morbi, ..	1841	13	0·66	7·78	Thoracis Morbi,	1829-30 1840	0	0	0
,, Alii Morbi,	1841	14	0·70	1·50	Alii Morbi, ...	1829	0	0	0
Total Diseases,	1841	154	7·71	2·83	Total Diseases,	1835	19	1·56	2·47
In the Month of October, ..	in 13 years.	91	0·64	4·55	In the Month of March, ..	in 13 years.	15	0·10	1·12

JOHN MURRAY,

Assistant Surgeon,

Horse Artillery.

TABLE No. III.

Comparative Table of Annual Admissions and Deaths in the European and Native Troops, Stationed at Kurnaul, from 1st January 1829, to 31st December 1841. From the Records in the Superintending Surgeon's Office.—By permission.

	Europeans.					Natives.				
Years.	Strength.	Diseases.		Ratio per cent. to Strength.	Deaths to Admissions.	Strength.	Diseases.		Ratio per cent. to Strength.	Deaths to Admissions.
1829.	285	Admitted,	564	197.89	1·77	3,357	Admitted,	1,612	47·98	1·42
		Died, ...	10	3.50			Died, ...	23	0.68	
1830.	222	Admitted,	311	140·09	1·60	2,557	Admitted,	1,144	44·74	0·87
		Died, ...	5	2·50			Died, ...	10	0·39	
1831.	1,194	Admitted,	1,558	130·31	2·11	2,560	Admitted,	1,136	44·37	0·96
		Died, ...	33	2·78			Died, ...	11	0·43	
1832	1,203	Admitted,	1,638	136·15	2·50	2,312	Admitted,	1,484	68·51	1·21
		Died, ...	41	3·40			Died, ...	17	0·73	
1833.	1,196	Admitted,	813	67·97	4·06	2,547	Admitted,	1,187	46·21	1·35
		Died, ...	33	2·84			Died, ...	16	0·63	
1834.	1,168	Admitted,	702	60·05	4·98	....	Admitted,	....	....	..
		Died, ...	35	2·99			Died, ...	....	....	
1835.	1,211	Admitted,	778	64·24	2·47	2,972	Admitted,	2,693	83·81	1·99
		Died, ...	19	1·56			Died, ...	53	1·77	
1836.	1,125	Admitted,	1,463	130·04	1·29	3,492	Admitted,	1,919	54·95	1·19
		Died, ...	19	1·68			Died, ...	23	0·66	
1837.	1,131	Admitted,	1,780	157·38	1·40	2,884	Admitted,	1,920	66·57	1·51
		Died, ...	25	2·29			Died, ...	29	1·00	
1838.	1,143	Admitted,	2,292	200·52	3·62	3,218	Admitted,	3,002	93·29	1·16
		Died, ...	83	7·26			Died, ...	35	1·09	
1839.	891	Admitted,	1,426	171·27	3·22	....	Admitted,	....	....	..
		Died, ...	46	5·05			Died, ...	....	....	
1840.	1,285	Admitted,	1,947	151·51	2·26	....	Admitted,	....	....	..
		Died, ...	44	3·42			Died, ...	....	....	
1841.	1997·6	Admitted,	5,437	272·12	2·83	....	Admitted,	....	....	..
		Died, ...	154	7·71			Died, ...	....	....	
......	14,052	Admitted,	20,709	147·38	2·64	....	Admitted,	....	....	..
		Died, ...	547	3·89			Died, ...	....	....	

John Murray, M. D.,
Assistant Surgeon,
Horse Artillery.

TABLE No. IV.

Comprehensive Table of the Admissions and Deaths in the European Troops Stationed at Kurnaul, for the year 1841. *From the Records in the Superintending Surgeon's Office.*

Year.	Months.	Strength.		Cholera.	Dysenteria.	Febris. Continua.	Febris. Miasmatica.	Splenitis.	Hepatitis.	Rheumatism.	Venerea.	Delirium Tremens.	Thoracis Morbi.	Ophthalmia.	Wounds and Accidents.	Alii Morbi.	Total.	Ratio per cent. to Strength.	Daily average, No. in Hospital.
	January,	1,929	Admitted,	..	28	14	35	..	10	12	60	1	22	6	20	66	274	14·20	200·26
			Died, ...	..	2	..	..	..	..	..	..	..	2	..	..	..	4	0·21	
	February,	1,927	Admitted,	..	18	21	17	..	12	3	23	2	19	8	31	63	217	11·26	170·22
			Died, ...	..	..	..	1	..	..	..	..	..	1	..	..	2	4	0·21	
	March, ..	2,114	Admitted,	..	33	11	34	3	16	20	65	4	6	5	17	92	306	14·47	169·64
			Died, ...	..	2	..	..	..	..	..	..	..	..	..	..	..	2	0·09	
	April, ..	2,106	Admitted,	1	53	25	80	1	24	19	64	3	15	7	21	96	409	19·42	204·50
			Died, ...	..	2	..	1	..	..	..	..	..	..	..	..	1	4	0·19	
	May, ..	2,104	Admitted,	3	49	11	78	3	19	19	79	10	7	8	14	101	401	19·06	215·32
			Died, ...	..	..	..	1	..	..	..	..	1	1	..	..	1	4	0·19	
	June, ..	2,103	Admitted,	..	49	15	75	1	19	12	47	5	16	7	19	102	367	17·45	239·84
			Died.	..	1	1	..	..	1	..	..	..	..	..	..	1	4	0·19	
	July, ..	2,083	Admitted,	5	61	29	100	5	31	14	57	12	9	6	17	126	472	22·18	262·90
			Died, ...	..	1	1	1	..	2	..	..	..	1	..	..	4	10	0·48	
	August, ..	2,071	Admitted,	7	52	69	327	4	11	12	40	5	12	7	10	98	654	31·28	329·50
			Died, ...	..	1	..	8	..	..	..	..	2	..	..	..	..	11	0·53	
	September	1,958	Admitted,	2	40	62	755	3	10	11	21	2	9	6	18	54	993	50·71	559·73
			Died, ...	..	9	..	24	..	1	..	..	..	..	..	..	1	35	1·79	
	October, ..	1,900	Admitted,	2	64	9	410	6	19	12	18	4	14	5	15	34	612	32·21	528·73
			Died, ...	..	8	..	24	..	1	..	..	..	6	..	..	1	40	2·10	
	November,	1,784	Admitted,	..	65	6	147	6	13	14	32	4	18	1	22	43	371	20·79	397·73
			Died, ...	..	10	..	6	..	2	..	..	..	2	..	..	1	21	1·17	
	December,	1,898	Admitted,	3	50	9	89	8	23	23	27	4	20	7	40	58	361	19·02	237·10
			Died, ...	..	7	..	5	..	..	..	..	1	..	..	..	2	15	0·79	
	Average,	1,998	Admitted,	23	562	281	2,147	40	207	171	533	56	167	73	244	933	5437	272·12	Average 292·95
			Died, ...	..	43	2	71	..	7	..	..	4	13	..	..	14	154	7·71	
	Average per cent. or Strength,		Admitted,	118	28·12	14·11	107·45	2·00	10·36	8·55	26·67	2·80	8·35	3·65	12·21	46·69	272·12	272·12	14·16
			Died, ...	..	2·15	0·10	3·55	..	0·35	..	..	0·20	0·65	..	..	0·70	7·71	7·71	

TABLE No. IV.—*(Continued.)*

Table of Admissions and Deaths from Fevers and other Diseases, with the relative proportions in the different European Corps stationed at Kurnaul, during the year 1841.

Corps.		Fevers.	Other Diseases.	Deaths to Admissions from Fever.	Deaths to Admissions from all Diseases.	Deaths to Strength.	Under Medical Charge of
Horse Art., Strength 113, ...	Admitted, Died, ...	63 6	204 9	9·52	4·41	7·98	Assistant Surgeon McGregor.
Foot Art. 10 months Average Strength 766,	Admitted, Died, ...	62 0	184 2	0·00	1·08	2·61	Surgeons Thompson and Dempster.
H. M. 3rd Dragoons Strength 530, ...	Admitted, Died, ...	396 5	1,114 17	1·27	1·52	3·20	Surgeon Henderson.
H. M. 3rd Buffs Strength 764, ...	Admitted, Died, ...	1,013 45	1,991 88	4·43	4·43	11·52	Surgeon McQueen.
H. C. 1st European Strength 514, ...	Admitted, Died, ...	1,024 15	2,009 38	1·46	1·89	7·39	Surgeon Mitchelson.
Total Strength 19,976,	Admitted, Died, ...	2,558 71	5,502 154	2·77	2.79	7·71	S. S. Panton.

Fifteenth Meeting of the British Association for the advancement of Science. Cambridge, 18th June, 1845.

The members assembled in the Senate House at eight o'clock, and the Dean of Ely, having taken the chair, stated that this meeting of the Association had a distinctive character from all preceding, by its connexion with the Magnetic Conference, which would include scientific men from all parts of Europe, who had resolved to meet on this occasion, and compare and co-ordinate there observations on magnetic and meteorological phenomena. He named several of the eminent men who had come to take a part in the conference, and alluded feelingly to the absence of Gauss, the great patriarch of magnetic science; and concluded by observing that the duties of his office were now fulfilled, and he had only to give place to Sir J. Herschel, whom he remembered as a competitor, but not as a rival, and with whom were associated those reminiscences which youth formed in its tenderness, and age hallowed in its memories.

Sir J. Herschel, who was suffering from a severe cold, on taking the chair, briefly adverted to the eulogy of the Dean of Ely, as characterized by the partiality of youthful friendship, and then, apologizing for his defects of voice, read the following address:—

The President's Address.

Gentlemen,—The terms of kindness in which I have been introduced to your notice by my predecessor in the office which you have called on me to fill, have been gratifying to me in no common degree —not as contributing to the excitement of personal vanity (a feeling which the circumstances in which I stand, and the presence of so many individuals every way my superiors, must tend powerfully to chastize), but as the emanation of a friendship begun at this University when we were youths together, preparing for our examinations for degrees, and contemplating each other, perhaps, with some degree of rivalry (if that can be called rivalry from which every spark of jealous feeling is absent). That friendship has since continued, warm and unshadowed for a single instant by the slightest cloud of disunion, and among all the stirring and deep-seated remembrances which the sight of these walls, within which we are now

assembled arouse, I can summon none more every way delightful and cheering than the contemplation of that mutual regard. It is therefore, with no common feelings that I find myself now placed in this chair, as the representative of such a body as the British Association, and as the successor of such a friend and of such a man as its late President.

Gentlemen,—There are many sources of pride and satisfaction, in which *self* has no place, which crowd upon a Cambridge man in revisiting for a second time this University, as the scene of our annual labours. The developement of its material splendour which has taken place in that interval of twelve years, vast and noble as it has been, has been more than kept pace with by the triumphs of its intellect, the progress of its system of instruction, and the influence of that progress on the public mind and the state of science in England. When I look at the scene around me—when I see the way in which our Sections are officered in so many instances by Cambridge men, not out of mere compliment to the body which receives us, but for the intrinsic merit of the men, and the pre-eminence which the general voice of society accords them in there several departments—when I think of the large proportion of the muster-roll of science which is filled by Cambridge names, and when, without going into any details, and confining myself to only one branch of public instruction, I look back to the vast and extraordinary developement in the state of mathematical cultivation and power in this University, as evidenced both in its examinations and in the published works of its members, now, as compared with what it was in my own time—I am left at no loss to account for those triumphs and that influence to which I have alluded. It has ever been, and I trust it ever will continue to be, the pride and boast of this University to maintain, at a conspicuously high level, that sound and thoughtful and sobering discipline of mind which mathematical studies imply. Independent of the power which such studies confer as instruments of investigation, there never was a period in the history of science in which their moral influence, if I may so term it, was more needed, as a corrective to that propensity which is beginning to prevail widely, and, I fear, banefully, over large departments of our philosophy, the propensity to crude and overhasty generalization. To all such propensities the steady concentration of

thought, and its fixation on the clear and the definite, which a long and stern mathematical discipline imparts, is the best, and, indeed, the only proper antagonist. That such habits of thought exist, and characterize, in a pre-eminent degree, the discipline of this University, with a marked influence on the subsequent career of those who have been thoroughly imbued with it, is a matter of too great notoriety to need proof. Yet, in illustration of this disposition, I may be allowed to mention one or two features of its Scientific History, which seem to me especially worthy of notice on this occasion. The first of these is the institution of the Cambridge University Philosophical Society, that body at whose more especial invitation we are now here assembled, which has now subsisted for more than twenty years, and which has been a powerful means of cherishing and continuing those habits among resident members of the University, after the excitement of reading for academical honours is past. From this society have emanated eight or nine volumes of memoirs, full of variety and interest, and such as no similar collection, originating as this has done in the bosom, and, in great measure, within the walls of an academical institution, can at all compare with; the Memoirs of the Ecole Polytechnique of Paris, perhaps, alone excepted. Without undervaluing any parts of this collection, I may be allowed to particularize, as adding largely to our stock of knowledge of their respective subjects, the Hydrodynamical contributions of Prof. Challis—the Optical and Photological papers of Mr. Airy—those of Mr. Murphy, on Definite Integrals—the curious speculations and intricate mathematical investigations of Mr. Hopkins on Geological Dynamics—and, more recently, the papers of Mr. De Morgan on the foundations of Algebra, which taken in conjunction with the prior researches of the Dean of Ely and Mr. Warren on the geometrical interpretation of imaginary symbols in that science, have effectually dissipated every obscurity which heretofore prevailed on the subject. The elucidation of the metaphysical difficulties in question, by this remarkable train of speculation, has in fact, been so complete, that henceforward they will never be named as difficulties, but only as illustrations of principle. Nor does its interest end here, since it appears to have given rise to the theory of Quaternions of Sir W. Hamilton, and to the Triple Algebra of Mr. De Morgan himself, as well as to a variety of interesting inquiries of a similar nature

on the part of Mr. Graves, Mr. Cayley, and others. Conceptions of a novel and refined kind have thus been introduced into analysis—new forms of imaginary expression rendered familiar—and a vein opened which I cannot but believe will terminate in some first-rate discovery in abstract science.

Neither are inquiries into the logic of symbolic analysis, conducted as these have been, devoid of a bearing on the progress even of physical science. Every inquiry, indeed, has such a bearing which teaches us that terms which we use in a narrow sphere of experience, as if we fully understood them, may, as our knowledge of nature increases, come to have superadded to them a new set of meanings and a wider range of interpretation. It is thus that modes of action and communication, which we hardly yet feel prepared to regard as strictly of a material character, may, ere many years have passed, come to be familiarly included in our notions of light, heat, electricity and other agents of this class; and that the transference of physical causation from point to point in space—nay, even the generation or developement of attractive, repulsive or directive forces at their points of arrival may come to be enumerated among their properties. The late marvellous discoveries in actino-chemistry and the phenomena of muscular contraction as dependent on the will, are, perhaps, even now preparing us for the reception of ideas of this kind.

Another instance of the efficacy of the course of study in this university, in producing not merely expert algebraists, but sound and original mathematical *thinkers*—(and, perhaps, a more striking one, from the generality of its contributors being men of comparatively junior standing,) is to be found in the publication of *The Cambridge Mathematical Journal*, of which already four volumes, full of very original communications, are before the public. It was set on foot in 1837, by the late Mr. Gregory, Fellow of Trinity College, whose premature death has bereft Science of one who, beyond a doubt, had he lived, would have proved one of its chief ornaments, and the worthy representative of a family already so distinguished in the annals of mathematical and optical science. His papers on the 'Calculus of Operations,' which appeared in that collection, fully justifies this impression, while they afford an excellent illustration

of my general position. Nor ought I to omit mentioning the Chemical Society, of whom he was among the founders, as indicative of the spirit of the place, untrammelled by abstract forms, and eager to spread itself over the whole field of human inquiry.

Another great and distinguishing feature in the scientific history of this place, is the establishment of its astronomical observatory, and the regular publication of the observations made in it. The science of astronomy is so vast, and its objects so noble, that its practical study for its own sake is quite sufficient to insure its pursuit wherever civilization exists. But such institutions have a much wider influence than that which they exercise in forwarding their immediate object. Every astronomical observatory which publishes its observations, becomes a nucleus for the formation around it of a school of exact practice—a standing and accessible example of the manner in which theories are brought to their extreme test—a centre, from which emanate a continual demand for and suggestion of refinements and delicacies, and precautions in matters of observation and apparatus, which re-act upon the whole body of science, and stimulate, while they tend to render possible an equal refinement and precision in all its processes. It is impossible to speak too highly of the mode in which the business of this institution is carried on, under its present eminent director—nor can it be forgotten in our appreciation of what it has done for science, that in it our present Astronomer-Royal first proved and familiarized himself with that admirable system of astronomical observation, registry, and computation, which he has since brought to perfection in our great national observatory, and which have rendered it, under his direction, the pride and ornament of British Science, and the admiration of Europe.

Gentlemen,—I should never have done if I were to enlarge on, or even attempt to enumerate the many proofs which this University has afforded of its determination to render its institutions and endowments efficient for the purposes of public instruction, and available to science. But such encomiums, however merited, must not be allowed to encroach too largely on other objects which I purpose to bring before your notice, and which relate to the more immediate business of the present meeting, and to the general interests of science. The first and every way the most important, is the subject

of the magnetic and meteorological observatories. Every member of this association is, of course, aware of the great exertions which have been made during the last five years, on the part of the British, Russian, and several other foreign governments, and of our own East India Company, to furnish data on the most extensive and systematic scale, for elucidating the great problems of terrestrial magnetism and meteorology, by the establishment of a system of observatories all over the world, in which the phenomena are registered at instants strictly simultaneous, and at intervals of two hours throughout both day and night. With the particulars of these national institutions, and of the mulititude of local and private ones of a similar nature, both in Europe, Asia and America, working on the same concerted plan, so far as the means at their disposal enable them, I need not detain you: neither need I enter into any detailed explanation of the system of magnetic surveys, both by sea and land, which have been executed or are in progress, in connexion with, and based upon the observations carried on at the fixed stations. These things form the subject of Special Annual Reports, which the Committee appointed for the purpose have laid before us at our several meetings, ever since the commencement of the undertaking; and the most recent of which will be read in the physical section of the present meeting, in its regular course. It is sufficient for me to observe, that the result has been the accumulation of an *enormous* mass of most valuable observations, which are now and have been for some time in the course of publication; and when thoroughly digested and discussed, as they are sure to be, by the talent and industry of magnetists and meteorologists, both in this country and abroad, cannot fail to place those sciences very far indeed in advance of their actual state. For such discussion, however, time must be allowed. Even were all the returns from the several observatories before the public, (which they are not, and are very far from being,) such is the mass of matter to be grappled with, and such the multitude of ways in which the observations will necessarily have to be grouped and combined to elicit mean results and quantitative laws, that several years must elapse before the full scientific value of the work done can possibly be realized.

Meanwhile, a question of the utmost moment arises, and which *must* be resolved, so far as the British Association is concerned,

before the breaking up of this meeting. The second term of three years, for which the British Government and the East India Company have granted their establishments—nine in number—will terminate with the expiration of the current year, at which period, if no provision be made for their continuance, the observations at those establishments will of course cease, and with them, beyond a doubt, those at a great many—probably the great majority—of the foreign establishments, both national and local, which have been called into existence by the example of England, and depend on that example for their continuance or adandonment. Now, under these circumstances, it becomes a very grave subject for the consideration of our committee of recommendations, whether to suffer this term to expire without an effort on the part of this association to influence the Government for its continuance, or whether, on the other hand, we ought to make such an effort, and endeavour to secure either the continuance of these establishments for a further limited term, or the perpetuity of this or some equivalent system of observation in the same or different localities, according to the present and future exigencies of science. I term this a grave subject of deliberation, and one which will call for the exercise of their soundest judgment; *because*, in the first place, this system of combined observation is by far the greatest and most prolonged effort of scientific co-operation which the world has ever witnessed; *because*, moreover, the spirit in which the demands of science have been met on this occasion by our own Government, by the Company, and by the other governments who have taken part in the matter, has been, in the largest sense of the words, munificent and unstinting; and *because* the existence of such a spirit throws upon us a solemn responsibility to recommend nothing but upon the most entire conviction of very great evils consequent on the interruption, and very great benefits to accrue to science from the continuance of the observations.

Happily we are not left without the means of forming a sound judgment on this tremendous question. It is a case in which, connected as the science of Britain is with that of the other co-operating nations, we cannot and ought not to come to any conclusion without taking into our counsels the most eminent magnetists and meteorologists of other countries who have either taken a direct part in the observations,

or whose reputation in those sciences is such as to give their opinions, in matters respecting them, a commanding weight. Accordingly it was resolved, at the York meeting last year, to invite the attendance of the eminent individuals I have alluded to at this meeting, with the especial objects of conference on the subject. And in the interval since elapsed, knowing the improbability of a complete personal reunion from so many distant quarters, a circular has been forwarded to each of them, proposing certain special questions for reply, and inviting, besides, the fullest and freest communication of their views on the general subject. The replies received to this circular, which are numerous and in the highest degree interesting and instructive, have been printed and forwarded to the parties replying, with a request for their reconsideration and further communication, and have also been largely distributed at home to every member of our own Council, and the Committee of recommendations, and to each member of the Council and Physical Committee of the Royal Society, which, conjointly with ourselves, memorialized Government for the establishment of the observatories.

In addition to the valuable matter thus communicated, I am happy to add, that several of the distinguished foreigners in question have responded to our invitation, and that in consequence this meeting is honoured by the personal presence of M. Kupffer, the Director-General of the Russian System of Magnetic and Meteorological Observation; of M. Ermann, the celebrated circumnavigator and meteorologist; of Baron von Senftenberg, the founder of the Astronomical, Magnetic, and Meteorological Observatory of Senftenberg; of M. Kreil, the director of the Imperial Observatory at Prague; and of M. Boguslawski, director of the Royal Prussian Observatory of Breslau, all of whom have come over for the express purpose of affording us the benefit of their advice and experience in this discussion. To all the conferences between these eminent foreigners and our own Magnetic and Meteorological Committee, and such of our members present as have taken any direct theoretical or practical interest in the subjects, all the members of our Committee of Recommendations, will have free access for the purpose of enabling them fully to acquaint themselves with the whole bearing of the case, and the arguments used respecting all the questions to be discussed,

so that when the subject comes to be referred to them, as it must be, if the opinion of the conference should be favourable to the continuance of the system, they may be fully prepared to make up their minds on it.

I will not say one word from this chair which can have the appearance of in any way anticipating the conclusion which the conference thus organized may come to, or the course to be adopted in consequence. But I will take this opportunity of stating my ideas generally on the position to be assumed by this association and by other scientific bodies in making demands on the national purse for scientific purposes. And I will also state, quite irrespective of the immediate question of magnetic co-operation, and therefore of the fate of this particular measure, what I conceive to be the objects which might be accomplished, and ought to be aimed at in the establishment, Physical Observatories, as part of the integrant institutions of each nation calling itself civilized, and as its contribution to terrestrial physics.

It is the pride and boast of an Englishman to pay his taxes cheerfully when he feels assured of their application to great and worthy objects. And as civilization advances, we feel constantly more and more strongly, that, after the great objects of national defence, the stability of our institutions, the due administration of justice, and the healthy maintenance of our social state, are provided for, there is no object greater and more noble—none more worthy of national effort, than the furtherance of science. Indeed, there is no surer test of the civilization of an age or nation, than the degree in which this conviction is felt. Among Englishmen it has been for a long time steadily increasing, and may now be regarded as universal among educated men of all classes. No government, and least of all a British government, can be insensible to the general prevalence of a sentiment of this kind ; and it is our good fortune, and has been so for several years, to have a government, no matter what its denomination as respects society, impressible with such considerations, and really desirous to aid the forward struggle of intellect, by placing at its disposal the material means of its advances.

But to do so with effect, it is necessary to be thoroughly well informed. The mere knowledge that such a disposition exists, is sufficient to

surround those in power with every form of extravagant pretension. And even if this were not so, the number of competing claims, which cannot be all satisfied, can only harass and bewilder, unless there be somewhere seated a discriminating and selecting judgment, which, among many important claims, shall fix upon the most important, and urge them with the weight of well-established character. I know not where such a selecting judgment can be so confidently looked for as in the great scientific bodies of the country, each in its own department, and in this association, constituted, in great measure, out of, and so representing them all, and numbering besides, among its members, abundance of men of excellent science and enlightened minds, who belong to none of them. The constitution of such a body is the guarantee both for the general soundness of its recommendations, and for the due weighing of their comparative importance, should ever the claims of different branches of science come into competition with each other.

In performing this most important office of suggesting channels through which the fertilizing streams of national munificence can be most usefully conveyed over the immense and varied fields of scientific culture, it becomes us, in the first place, to be so fully impressed with a sense of duty to the great cause for which we are assembled, as not to hesitate for an instant in making a recommendation of whose propriety we are satisfied, on the mere ground that the aid required, is of great and even of unusual magnitude. And on the other hand, keeping within certain reasonable limits of total amount, which each individual must estimate for himself, and which it would be unwise, and indeed impossible, to express in terms, it will be at once felt that *economy in asking* is quite as high a "distributive virtue" as economy in *granting*, and that every pound, recommended unnecessarily, is so much character thrown away. I make these observations because the principles they contain cannot be too frequently impressed, and by no means, because I consider them to have been overstepped in any part of our conduct hitherto. In the next place, it should be borne in mind that, in recommending to Government, not a mere grant of money, but a scientific enterprise or a national establishment, whether temporary or permanent, not only is it our duty so to place it before them, that its grounds of recommendation shall be thoroughly intel-

ligible, but that its whole proposed extent shall be seen—or at least if they cannot be, that it should be clearly stated to be the possible commencement of something more extensive—and besides, that the printing and publication of results should, in every such case, be made an express part of the recommendation. And, again, we must not forget that our interest in the matter does not cease with such publication. It becomes our duty to forward, by every encouragement in our power, the due consideration and scientific discussion of results so procured—to urge it upon the science of our own country and of Europe, and to aid from our own resources those who may be willing to charge themselves with their analysis, and to direct or execute the numerical computations or graphical projections it may involve. This is actually the predicament in which we stand, in reference to the immense mass of data already accumulated by the magnetic and meteorological observatories. Let the science of England, and especially the rising and vigorous mind which is pressing onward to distinction, gird itself to the work of grappling with this mass. Let it not be said that we are always to look abroad whenever industry and genius are required to act in union for the discussion of great masses of raw observation. Let us take example from what we see going on in Germany, where a Dove, a Kämtz and a Mahlmann are battling with the meteorology; a Gauss, a Weber and an Ermann with the magnetism of the world. The mind of Britain is equal to the task—its mathematical strength, developed of late years to an unprecedented extent, is competent to any theoretical analysis or technical combination. Nothing is wanting but the resolute and persevering devotion of undistracted thought to a single object, and that will not be long wanting, when once the want is declared and dwelt upon, and the high prize of public estimation held forth to those who fairly and freely adventure themselves in this career. Never was there a time when the mind of the country, as well as its resources of every kind, answered so fully and readily to any call reasonable in itself and properly urged upon it. Do we call for *facts?* they are poured upon us in such profusion as for a time to overwhelm us, like the Roman maid who sank under the load of wealth she called down upon herself. Witness the piles of unreduced meteorological observations which load our shelves and archives;

witness the immense and admirably arranged catalogues of stars, which have been and still are pouring in from all quarters upon our astronomy, so soon as the want of extensive catalogues came to be felt and declared. What we now want is *thought,* steadily directed to single objects, with a determination to eschew the besetting evil of our age—the temptation to squander and dilute it upon a thousand different lines of inquiry. The philosopher must be wedded to his subject if he would see the children and the children's children of his intellect flourishing in honour around him.

The establishment of astronomical observatories has been, in all ages and nations, the first public recognition of science as an integrant part of civilization. Astronomy, however, is only one out of many sciences, which can be advanced by a combined system of observation and calculation carried on uninterruptedly, where, in the way of experiment, man has no control, and whose only handle is the continual observation of Nature, as it developes itself under our eyes, and a constant collateral endeavour to concentrate the records of that observation into empirical laws in the first instance, and to ascend from those laws to theories. Speaking in a utilitarian point of view, the globe which we inhabit is quite as important a subject of scientific inquiry as the stars. We depend for our bread of life and every comfort, on its climates and seasons, on the movement of its winds and waters. We guide ourselves over the ocean, when astronomical observations fail, by our knowledge of the laws of its magnetism; we learn the sublimest lessons from the records of its geological history; and the great facts which its figure, magnitude, and attraction, offer to mathematical inquiry form the very basis of Astronomy itself. Terrestrial Physics, therefore, form a subject every way worthy to be associated with Astronomy as a matter of universal interest and public support, and one which cannot be adequately studied except in the way in which Astronomy itself has been—by permanent establishments keeping up an unbroken series of observation:—but with this difference, that whereas the chief data of Astronomy might be supplied by the establishment of a very few well worked observatories properly disposed in the two hemispheres—the gigantic problems of meteorology, magnetism, and oceanic movements can only be resolved by a far more extensive geographical

distribution of observing stations, and by a steady, persevering, systematic attack, to which every civilized nation, as it has a direct interest in the result, ought to feel bound to contribute its contingent.

I trust that the time is not far distant when such will be the case, and when no nation, calling itself civilized, will deem its institutions complete, without the establishment of a permanent physical observatory, with at least so much provision for astronomical and magnetic observation as shall suffice to make it a local centre of reference for geographical determination and trigonometrical and magnetic surveys —which latter, if we are ever to attain to a theory of the secular changes of the earth's magnetism, will have to be repeated at intervals of twenty or thirty years for a long while to come. Rapidly progressive as our colonies are, and emulous of the civilization of the mother country, it seems not too much to hope from them, that they should take upon themselves, each according to its means, the establishment and maintenance of such institutions, both for their own advantage and improvement, and as their contributions to the science of the world. A noble example has been set them in this respect, within a very few months, by our colony of British Guiana, in which a society recently constituted, in the best spirit of British co-operation, has established and endowed an observatory of this very description, furnishing it partly from their own resources, and partly by the aid of Government with astronomical, magnetic, and meteorological instruments, and engaging a competent observer, at a handsome salary, to work the establishment—an example which deserves to be followed wherever British enterprise has struck root and flourished.

The perfectly unbroken and normal registry of all the meteorological and magnetic elements—and of tidal fluctuations where the locality admits—would form the staple business of every such observatory, and, according to its means of observation, periodical phenomena of every description would claim attention, for which the list supplied by M. Quetelet, which extends not merely to the phases of inanimate life, but to their effects on the animal and vegetable creation, will leave us at no loss beyond the difficulty of selection. The division of phenomena which magnetic observation has suggested, into periodical, secular, and occasional, will apply *mutatis mutandis* to every

department. Under the head of occasional phenomena, storms, magnetic disturbances, auroras, extraordinary tides, earthquake movements, meteors, &c., would supply an ample field of observation—while among the secular changes, indications of the varying level of land and sea, would necessitate the establishment of permanent marks, and the reference to them of the actual mean sea level which would emerge from a series of tidal observations, carried round a complete period of the moon's nodes with a certainty capable of detecting the smallest changes.

The abridgment of the merely mechanical work of such observatories by self-registering apparatus, is a subject which cannot be too strongly insisted on. Neither has the invention of instruments for superseding the necessity of much arithmetical calculation by the direct registry of *total* effects, received anything like the attention it deserves. Considering the perfection to which mechanism has arrived in all its departments, these contrivances promise to become of immense utility. The more the merely mechanical part of the observer's duty can be alleviated, the more will he be enabled to apply himself to the theory of his subject, and to perform what I conceive ought to be regarded as the most important of all his duties, and which in time will come to be universally so considered—I mean the systematic deduction from the registered observations of the mean values and local co-efficients of diurnal, menstrual, and annual change. These deductions, in the case of permanent institutions, ought not, if possible, to be thrown upon the public, and their effective execution would be the best and most honourable test of the zeal and ability of their directors.

Nothing damps the ardour of an observer like the absence of an object appreciable and attainable by himself. One of my predecessors in this chair has well remarked, that a man may as well keep a register of his dreams as of the weather, or any other set of daily phenomena, if the spirit of grouping, combining, and eliciting results be absent. It can hardly be expected indeed, that, observers of facts of this nature should themselves reason from them up to the highest theories. For that their position unfits them, as they see but locally and partially. But no other class of persons stands in anything like so favourable a position for working out the first elementary laws of

phenomena, and referring them to their immediate points of dependence. Those who witness their daily progress, with that interest which a direct object in view inspires, have in this respect an infinite advantage over those who have to go over the same ground in the form of a mass of dry figures. A thousand suggestions arise, a thousand improvements occur—a spirit of interchange of ideas is generated, the surrounding district is laid under contribution for the elucidation of innumerable points, where a chain of corresponding observation is desirable; and what would otherwise be a scene of irksome routine, becomes a school of physical science. It is needless to say how much such a spirit must be excited by the institution of provincial and colonial scientific societies, like that which I have just had occasion to mention. Sea as well as land observations are, however, equally required for the effectual working out of these great physical problems. A ship is an itinerant observatory; and, in spite of its instability, one which enjoys several eminent advantages—in the uniform level and nature of the surface, which eliminate a multitude of causes of disturbance and uncertainty, to which land observations are liable. The exceeding precision with which magnetic observations can be made at sea, has been abundantly proved in the Antarctic Voyage of Sir James Ross, by which an invaluable mass of data has been thus secured to science. That voyage has also conferred another and most important accession to our knowledge, in the striking discovery of a permanently low barometric pressure in high south latitudes over the whole Antarctic ocean—a pressure actually inferior by considerably more than an inch of mercury, to what is found between the Tropics. A fact so novel and remarkable will, of course, give rise to a variety of speculations as to its cause; and I anticipate one of the most interesting discussions which have ever taken place in our Physical Section, should that great circumnavigator favour us, I hope he will, with a *vivâ voce* account of it. The voyage now happily commenced under the most favourable auspicies for the further prosecution of our Arctic discoveries under Sir John Franklin, will bring to the test of direct experiment a mode of accounting for this extraordinary phenomenon thrown out by Colonel Sabine, which, if realized, will necessitate a complete revision of our whole system of barometric observation in high latitudes, and a total reconstruction of all our knowledge of the laws of pressure in regions

where excessive cold prevails. This, with the magnetic survey of the Arctic seas, and the not improbable solution of the great geographical problem which forms the chief object of the expedition, will furnish a sufficient answer to those, if any there be, who regard such voyages as useless. Let us hope and pray, that it may please Providence to shield him and his brave companions from the many dangers of their enterprise, and restore them in health and honour to their country.

I cannot quit this subject without reverting to, and deploring the great loss which science has recently sustained in the death of the late Prof. Daniell, one of its most eminent and successful cultivators in this country. His work on Meteorology is, if I mistake not, the first in which the distinction between the aqueous and gaseous atmospheres, and their mutual independence, was clearly and strongly insisted on as a highly influential element in meteorological theory. Every succeeding investigation has placed this in a clearer light. In the hands of M. Dove, and more recently of Colonel Sabine, it has proved the means of accounting for some of the most striking features in the diurnal variations of the barometer. The continual generation of the aqueous atmosphere at the Equator, and its destruction in high latitudes, furnishes a *motive power* in meteorology, whose mode of action, and the mechanism through which it acts, have yet to be inquired into. Mr. Daniell's claims to scientific distinction were, however, not confined to this branch. In his hands, the voltaic pile became an infinitely more powerful and manageable instrument, than had ever before been thought possible; and his improvements in its construction (the effect not of accident, but of patient and persevering experimental inquiry), have in effect, changed the face of electro-chemistry. Nor did he confine himself to these improvements. He applied them: and among the last and most interesting inquiries of his life, are a series of electro-chemical researches, which may rank with the best things yet produced in that line.

The immediate importance of these subjects to one material part of our business at this meeting, has caused me to dwell more at length than perhaps I otherwise should on them. I would gladly use what time may remain without exciting your impatience, in taking a view of some features in the present state and future prospects of that branch of science to which my own attention has been chiefly

directed, as well as to some points in the philosophy of science generally, in which it appears to me that a disposition is becoming prevalent towards lines of speculation, calculated rather to bewilder than enlighten, and, at all events, to deprive the pursuit of science of that which, to a rightly constituted mind, must ever be one of its highest and most attractive sources of interest, by reducing it to a mere assemblage of marrowless and meaningless facts and laws.

The last year must ever be considered an epoch in Astronomy, from its having witnessed the successful completion of the Earl of Rosse's six-feet reflector—an achievement of such magnitude, both in itself as a means of discovery, and in respect of the difficulties to be surmounted in its construction, (difficulties which perhaps few persons here present are better able from experience to appreciate than myself), that I want words to express my admiration of it. I have not myself been so fortunate as to have witnessed its performance, but from what its noble constructor has himself informed me of its effects on one particular nebula, with whose appearance in powerful telescopes I am familiar, I am prepared for any statement which may be made of its optical capacity. What may be the effect of so enormous a power in adding to our knowledge of our own immediate neighbours in the universe, it is of course impossible to conjecture; but for my own part I cannot help contemplating, as one of the grand fields open for discovery with such an instrument, those marvellous and mysterious bodies or systems of bodies, the Nebulæ. By far the major part, probably, at least, nine-tenths of the nebulous contents of the heavens consist of nebulæ of spherical or elliptical forms, presenting every variety of elongation and central condensation. Of these a great number have been resolved into distinct stars, and a vast multitude more have been found to present that mottled appearance, which renders it almost a matter of certainty, that an increase of optical power would show them to be similarly composed. A not unnatural or unfair induction would therefore seem to be, that those which resist such resolution do so only in consequence of the smallness and closeness of the stars of which they consist; that, in short, they are only optically and not physically nebulous. There is, however, one circumstance which deserves especial remark, and which, now that my own observation has extended to the nebulæ

of both hemispheres, I feel able to announce with confidence as a general law, viz. that the character of easy resolvability into separate and distinct stars, is almost entirely confined to nebulæ deviating but little from the spherical form; while, on the other hand, very elliptic nebulæ, even large and bright ones, offer much greater difficulty in this respect. The cause of this difference must, of course, be conjectural, but, I believe, it is not possible for any one to review *seriatim* the nebulous contents of the heavens without being satisfied of its reality as a physical character. Possibly the limits of the conditions of dynamical stability in the spherical cluster may be compatible with less numerous and comparatively larger individual constituents than in an elliptic one. Be that as it may, though there is no doubt a great number of elliptic nebulæ in which stars have *not* yet been noticed, yet there are so many in which they *have*, and the gradation is so insensible from the most perfectly spherical to the most elongated elliptic form, that the force of the general induction is hardly weakened by this peculiarity; and for my own part I should have little hesitation in admitting all nebulæ of this class to be, in fact, congeries of stars. And this seems to have been my father's opinion of their constitution, with the exception of certain very peculiar looking objects, respecting whose nature all opinion must for the present be suspended. Now among all the wonders which the heavens present to our contemplation, there is none more astonishing than such close compacted families or communities of stars, forming systems either insulated from all others, or in binary connexion, as double clusters whose confines intermix, and consisting of individual stars nearly equal in apparent magnitude, and crowded together in such multitudes as to defy all attempts to count or even to estimate their numbers. What *are* these mysterious families? Under what dynamical conditions do they subsist? Is it conceivable that they can exist at all, and endure under the Newtonian law of gravitation without perpetual collisions? And, if so, what a problem of unimaginable complexity is presented by such a system if we should attempt to dive into its perturbations and its conditions of stability by the feeble aid of our analysis. The existence of a luminous matter, not congregated into massive bodies in the nature of stars, but disseminated

through vast regions of space in a vaporous or cloud-like state, undergoing, or awaiting the slow process of aggregation into masses by the power of gravitation, was originally suggested to the late Sir W. Herschel in his reviews of the nebulæ, by those extraordinary objects which his researches disclosed, which exhibit no regularity of outline, no systematic gradation of brightness, but of which the wisps and curls of a cirrhus cloud afford a not inapt description. The wildest imagination can conceive nothing more capricious than their forms, which in many instances seem totally devoid of plan as much so as real clouds,—in others offer traces of a regularity hardly less uncouth and characteristic, and which in some cases seems to indicate a cellular, in others, a sheeted structure, complicated in folds as if agitated by internal winds.

Should the powers of an instrument such as Lord Rosse's succeed in resolving these also into stars, and, moreover, in demonstrating the starry nature of the regular elliptic nebulæ, which have hitherto resisted such decomposition, the idea of a *nebulous matter,* in the nature of shining fluid, or condensible gas, must, of course, cease to rest on any support derived from actual observation in the sidereal heavens, whatever countenance it may still receive in the minds of cosmogonists from the tails and atmospheres of comets, and the zodiacal light in our own system. But though all idea of its being ever given to mortal eye, to view aught that can be regarded as an outstanding portion of primæval chaos, be dissipated, it will by no means have been even then demonstrated that among those stars, so confusedly scattered, no aggregating powers are in action, tending to draw them into groups and insulate them from neighbouring groups; and, speaking from my own impressions, I should say that, in the structure of the Magellanic Clouds, it is really difficult not to believe we see distinct evidences of the exercise of such a power. This part of my father's general views of the construction of the heavens, therefore, being entirely distinct from what has of late been called "the nebulous hypothesis," will still subsist as a matter of rational and philosophical speculation,—and perhaps all the better for being separated from the other.

Much has been said of late of the nebulous hypothesis, as a mode of representing the origin of our own planetary system. An idea of

Laplace, of which it is impossible to deny the ingenuity, of the successive abandonment of planetary rings, collecting themselves into planets by a revolving mass, gardually shrinking in dimension by the loss of heat, and finally concentrating itself into a sun, has been insisted on with some pertinacity, and supposed to receive almost demonstrative support from considerations to which I shall presently refer. I am by no means disposed to quarrel with the nebulous hypothesis even in this form, as a matter of pure speculation, and without any reference to final causes; but if it is to be regarded as a demonstrative truth, or as receiving the smallest support from any observed numerical relations which actually hold good among the elements of the planetary orbits, I beg leave to demur. Assuredly, it receives no support from observation of the effects of sidereal aggregation, as exemplified in the formation of globular and elliptic clusters, supposing *them* to have resulted from such aggregation. For were this the cause, working itself out in thousands of instances, it would have resulted, *not* in the formation of a single large central body, surrounded by a few much smaller attendants, disposed in one plane around it,—but in systems of infinitely greater complexity, consisting of multitudes of nearly equal luminaries, grouped together in a solid elliptic or globular form. So far, then, as any conclusion from our observations of nebulæ can go, the result of agglomerative tendencies *may*, indeed, be the formation of families of stars of a general and very striking character; but we see nothing to lead us to presume its further result to be the surrounding of those stars with planetary attendants. If, therefore, we go on to push its application to that extent, we clearly theorize in advance of all inductive observation.

But if we go still farther, as has been done in a philosophical work of much mathematical pretension, which has lately come into a good deal of notice in this conntry,* and attempt "to give a mathematical consistency" to such a cosmogony by the "*indispensable criterion*" of "a numerical verification,"—and so exhibit, as "necessary consequences of such a mode of formation," a series of numbers which observation has established independent of any such hypothesis, as primordial elements of our system—if, in pursuit of this

* M. Comte, Phil. Positive, ii. 376.

idea, we find the author first computing the time of rotation the sun must have had about its axis, so that a planet situated on its surface and forming a part of it should not press on that surface, and should therefore be in a state of indifference as to its adhesion or detachment—if we find him, in this computation, throwing overboard, as troublesome, all those essential considerations of the law of cooling, the change of spheroidical form, the internal distribution of density, the probable non-circulation of the internal and external shells in the same periodic time, on which alone it is possible to execute such a calculation correctly; and avowedly, as a short cut to a result, using as the basis of his calculation "the elementary Huyghenian theorems for the evaluation of centripetal forces in combination with the law of gravitation";—a combination which, I need not explain to those who have read the first book of Newton, leads direct to Kepler's law;—and if we find him then gravely turning round upon us and adducing the coincidence of the resulting periods compared with the distance of the planets with this law of Kepler, as *being* the numerical verification in question,—where, I would ask, is there a student to be found who has graduated as a Senior Optime in this University, who will not at once lay his finger on the fallacy of such an argument,* and declare it a vicious circle? I really

* M. Comte ('Philosophie Positive,' ii. 376, &c.), the author of the reasoning alluded to, assures us that his calculations lead to results agreeing only approximately with the exact periods, a difference to the amount of 1/45, the part more or less existing in all. As he gives neither the steps nor the data of his calculations, it is impossible to trace the origin of this difference,—which, however, *must* arise from error *somewhere*, if his fundamental principle be really what he states. For the Huyghenian measure of centrifugal force $\left(F \times \frac{V2}{R}\right)$ "combined" with "the law of gravitation" $\left(F \times \frac{M+m}{R\,2}\right)$, replacing V by its equivalent, $\frac{R}{P}$ can result in no other relation between P and R than what is expressed in the Keplerian law, and is incompatible with the smallest deviation from it.

Whether the sun threw off the planets or not, Kepler's law *must* be obeyed by them when once fairly detached. How, then, can their actual observance of this law be adduced in proof of their origin, one way or the other? How is it proved that the sun must have thrown off planets *at those distances, and at no others*, where we find them,—no matter in what times revolving? *That*, indeed, would be a powerful presumptive argument; but what geo-

should consider some apology needed for even mentioning an argument of the kind to such a meeting, were it not that this very reasoning, so ostentatiously put forward, and so utterly baseless, has been eagerly received among us* as the revelation of a profound analysis. When such is the case, it is surely time to throw in a word of warning, and to reiterate our recommendation of an early initiation into mathematics, and the cherishing a mathematical habit of thought, as the safeguard of all philosophy.

A very great obstacle to the improvement of telescopes in this country has been happily removed within the past year by the repeal of the duty on glass. Hitherto, owing to the enormous expense of experiments to private individuals not manufacturers—and to the heavy excise duties imposed on the manufacturer, which has operated to repress all attempts on the part of practical men to produce glass adapted to the construction of large achromatics, our opticians have been compelled to resort abroad for their materials—purchasing them at enormous prices, and never being able to procure the largest sizes. The skill, enterprise and capital of the British manufacturer have now free scope, and it is our own fault if we do not speedily rival, and perhaps outdo the far-famed works of Munich and Paris. Indeed, it is hardly possibly to over-estimate the effect of this fiscal change on a variety of other sciences to which the costliness of glass apparatus has been hitherto an exceeding drawback, not only from the actual expense of apparatus already in common use, but as repressing the invention and construction of new applications of this useful material.

A great deal of attention has been lately, and I think very wisely, drawn to the philosophy of science and to the principles of logic, as founded, not on arbitrary and pedantic forms, but on a careful inductive inquiry into the grounds of human belief, and the nature and extent of man's intellectual faculties. If we are ever to hope that science will extend its range into the domain of social conduct, and model the course of human actions on that thoughtful and effective

meter will venture on such a *tour d'analyse*? And, lastly, how can it be adduced as *a numerical coincidence of an hypothesis with observed fact* to say, that, at an unknown epoch, the sun's rotation *(not observed) must have been* so and so, *if* the hypothesis were a true one?

* Mill. Logic, ii. 28.—Also, 'Vestiges of the Creation,' p. 17.

adaptation of means to their end, which is its fundamental principle in all its applications (the *means* being here the total devotion of our moral and intellectual powers—the *end,* our own happiness and that of all around us)—if such be the far hopes and long protracted aspirations of science, its philosophy and its logic assume a paramount importance, in proportion to the practical danger of erroneous conceptions in the one, and fallacious tests of the validity of reasoning in the other.

On both these subjects works of first-rate importance have of late illustrated the scientific literature of this country. On the philosophy of science, we have witnessed the production, by the pen of a most distinguished member of this University, of a work so comprehensive in its views, so vivid in its illustrations, and so right-minded in its leading directions, that it seems to me impossible for any man of science, be his particular department of inquiry what it may, to rise from its perusal without feeling himself strengthened and invigorated for his own especial pursuit, and placed in a more favourable position for discovery in it than before, as well as more competent to estimate the true philosophical value and import of any new views which may open to him in its prosecution. From the peculiar and *a priori* point of view in which the distinguished author of the work in question has thought proper to place himself before his subject, many may dissent; and I own myself to be of the number;—but from this point of view it is perfectly possible to depart without losing sight of the massive reality of that subject itself: on the contrary, that reality will be all the better seen and understood, and its magnitude felt, when viewed from opposite sides, and under the influence of every accident of light and shadow which peculiar habits of thought may throw over it.

Accordingly, in the other work to which I have made allusion, and which, under the title of a 'System of Logic,' has for its object to give "*a connected view of the principles of evidence and the methods of scientific investigation*"—its acute, and in many respects profound author—taking up an almost diametrically opposite station, and looking to experience as the ultimate foundation of all knowledge—at least, of all scientific knowledge—in its simplest axioms as well as in its most remote results—has presented us with a view of the inductive philosophy, very different indeed in its general aspect—

but in which, when carefully examined, most essential features may be recognized as identical, while some are brought out with a salience and effect which could not be attained from the contrary point of sight. It cannot be expected that I should enter into any analysis or comparison of these remarkable works—but it seemed to me impossible to avoid pointedly mentioning them on this occasion, because they certainly, taken together, leave the philosophy of science, and indeed *the principles of all general reasoning,* in a very different state from that in which they found them. Their influence, indeed, and that of some other works of prior date, in which the same general subjects have been more lightly touched upon, has already begun to be felt and responded to from a quarter where, perhaps any sympathy in this respect might hardly have been looked for. The philosophical mind of Germany has begun, at length, effectually to awaken from the dreamy trance in which it had been held for the last half-century, and in which the jargon of the Absolutists and Ontologists had been received as oracular. An "anti-speculative philosophy" has arisen and found supporters—rejected, indeed, by the Ontologists, but yearly gaining ground in the general mind. It is something so new for an English and a German philosopher to agree in their estimate either of the proper objects of speculation or of the proper mode of pursuing them, that we greet, not without some degree of astonishment, the appearance of works like the Logic and the New Psychology of Beneke, in which this false and delusive philosophy is entirely thrown aside, and appeal at once to the nature of things as we find them, and to the laws of our intellectual and moral nature, as our own consciousness and the history of mankind reveals them to us.*

Meanwhile, the fact is every year becoming more broadly manifest, by the successful application of scientific principles to subjects which had hitherto been only empirically treated (of which agriculture may be taken as perhaps the most conspicuous instance,) that the great work of Bacon was not the completion, but, as he himself foresaw and foretold, only the commencement of his own philosophy; and that we are even yet only at the threshold of that palace of

* *Vide* Beneke, Neue Psychologie, s. 300 et seq. for an admirable view of the state of metaphysical and logical philosophy in England.

Truth, which succeeding generations will range over as their own—a world of scientific inquiry, in which not matter only and its properties, but the far more rich and complex relations of life and thought, of passion and motive, interest and actions, will come to be regarded as its legitimate objects. Nor let us fear that in so regarding them, we run the smallest danger of collision with any of those great principles which we regard, and rightly regard, as sacred from question. A faithful and undoubting spirit carried into the inquiry, will secure us from such dangers, and guide us, like an instinct, in our paths through that vast and enlarged region which intervenes between those ultimate principles and their extreme practical applications. It is only by working our way *upwards towards* those principles, as well as *downwards from them,* that we can ever hope to penetrate such intricacies, and thread their maze; and it would be worse than folly—it would be treason against all our highest feelings—to doubt that to those who spread themselves over these opposite lines, each moving in his own direction, a thousand points of meeting and mutual and joyful recognition will occur.

But if Science be really destined to expand its scope, and embrace objects beyond the range of merely material relation, it must not altogether and obstinately refuse, even within the limits of such relations, to admit conceptions which at first sight may seem to trench upon the immaterial, such as we have been accustomed to regard it. The time seems to be approaching when a merely mechanical view of nature will become impossible—when the notion of accounting for *all* the phenomena of nature, and even of mere physics, by simple attractions and repulsions fixedly and unchangeably inherent in material centres (granting any conceivable system of Boscovichian alternations), will be deemed untenable. Already we have introduced the idea of *heat-atmospheres* about particles, to vary their repulsive forces according to definite laws. But surely this can only be regarded as one of those provisional and temporary conceptions which, though it may be useful as helping us to laws, and as suggesting experiments, we must be prepared to resign if ever such ideas, for instance, as radiant stimulus or conducted influence should lose their present vagueness, and come to receive some distinct scientific interpretation. It is one thing, however, to suggest that our present language and conceptions should

be held as provisional—another to recommend a general unsettling of all received ideas. Whatever innovations of this kind may arise, they can only be introduced slowly, and on a full sense of their necessity; for the limited faculties of our nature will bear but little of this sort at a time without a kind of intoxication, which precludes all rectilinear progress—or, rather, all progress whatever, except in a direction which terminates in the wildest vagaries of mysticism and clairvoyance.

But, without going into any subtleties, I may be allowed to suggest that it is at least high time that philosophers, both physical and others, should come to some nearer agreement than appears to prevail as to the meaning they intend to convey in speaking of causes and causation. On the one hand we are told that the grand object of physical inquiry is to explain the phenomena of nature, by referring them to their causes: on the other, that the inquiry into causes is altogether vain and futile, and that Science has no concern, but with the discovery of *laws*. Which of these is the truth? Or are both views of the matter true on a different interpretation of the terms? Whichever view we may take, or whichever interpretation adopt, there is one thing certain,—the extreme inconvenience of such a state of language. This can only be reformed by a careful analysis of this widest of all human generalizations, disentangling from one another the innumerable shades of meaning which have got confounded together in its progress, and establishing among them a rational classification and nomenclature. Until this is done we cannot be sure, that by the relation of cause and effect, one and the same kind of relation is understood. Indeed, using the words as we do, we are quite sure that the contrary is often the case; and so long as uncertainty in this respect is suffered to prevail, so long will this unseemly contradiction subsist, and not only prejudice the cause of science in the eyes of mankind, but create disunion of feeling, and even give rise to accusations and recriminations on the score of principle among its cultivators.

The evil I complain of becomes yet more grievous when the idea of *law* is brought so prominently forward as not merely to throw into the background that of *cause*, but almost to thrust it out of view altogether; and if not to assume something approaching to the character of direct agency, at least to place itself in the position of a substitute for what

mankind in general understand by *explanation*: as when we are told, for example, that the successive appearance of races of organized beings on earth, and their disappearance, to give place to others, which Geology teaches us,—is a result of some certain law of developement, in virtue of which an unbroken chain of gradually exalted organization from the crystal to the globule, and thence, through the successive stages of the polypus, the mollusk, the insect, the fish, the reptile, the bird, and the beast, up to the monkey and the man (nay, for aught we know, even to the angel), has been (or remains to be) evolved. Surely, when we hear such a theory, the natural human craving after *causes*, capable in some conceivable way of giving rise to such changes and transformations of organ and intellect,—*causes why* the developement at different parts of its progress should divaricate into different lines,—*causes*, at all events, intermediate between the steps of the developement—becomes importunate. And when nothing is offered to satisfy this craving, but loose and vague reference to *favourable circumstances* of climate, food, and general situation, which no experience has ever shown to convert one species into another; who is there who does not at once perceive that such a theory is in no respect more *explanatory*, than that would be which simply asserted a miraculous intervention, at every successive step of that unknown series of events, by which the earth has been alternately peopled and dispeopled of its denizens?

A *law* may be a *rule* of action, but it is not *action*. The Great First Agent may lay down a rule of action for himself, and that rule may become known to man by observation of its informity: but constituted as our minds are, and having that conscious knowledge of causation, which is forced upon us by the reality of the distinction between *intending* a thing, and *doing* it, we can never substitute the *Rule* for the *Act*. Either directly, or through delegated agency, whatever takes place is not merely *willed*, but *done*, and what is done we then only declare to be explained, when we can trace a process, and show that it consists of steps analogous to those we observe in occurrences which have passed often enough before our own eyes to have become familiar, and to be termed *natural*. So long as no such process can be traced and analyzed out in this manner, so long the phenomenon is unexplained, and remains equally so, whatever be the

number of unexplained steps inserted between its beginning and its end. The transition from an inanimate crystal to a globule, capable of such endless organic and intellectual developement, is *as* great a step—*as* unexplained a one—*as* unintelligible to us—and, in any human sense of the word, as *miraculous* as the immediate creation and introduction upon earth of every species and every individual would be. Take these amazing facts of geology which way we will, we must resort elsewhere than to a mere speculative law of developement for their explanation.

Visiting as we do once more this scene of one of our earliest and most agreeable receptions—as travellers on the journey of life brought back by the course of events to scenes associated with exciting recollections and the memory of past kindness—we naturally pause and look back on the interval with that interest which always arises on such occasions, "How has it fared with you meanwhile"? we fancy ourselves asked.—"How have you prospered?"—"Has this long interval been well or ill spent?"—"How is it with the cause in which you have embarked?"—"Has it flourished or receded, and to what extent have you been able to advance it?" To all these questions we may, I believe, conscientiously, and with some self-gratulation, answer—Well! The young and then but partially fledged institution has become established and matured. Its principles have been brought to the test of a long and various experience, and been found to work according to the expectations of its founders. Its practice has been brought to uniformity and consistency, on rules which, on the whole, have been found productive of no inconvenience to any of the parties concerned. Our calls for reports on the actual state and deficiencies of important branches of science, and on the most promising lines of research in them, have been answered by most valuable and important essays from men of the first eminence in their respective departments, not only condensing what is known, but adding largely to it, and in a multitude of cases entering very extensively indeed into original inquiries and investigations—of which Mr. Scott Russell's Report on Waves, and Mr. Capenter's on the Structure of Shells, and several others in the most recently published volume of our Reports, that for the York meeting last summer, may be specified as conspicuous instances.

Independent of these Reports, the original communications read or verbally made to our several Sections, have been in the highest degree interesting and copious; not only as illustrating and extending almost every branch of science, but as having given rise to discussions and interchanges of idea and information between the members present, of which it is perfectly impossible to appreciate sufficiently the influence and value. Ideas thus communicated fructify in a wonderful manner on subsequeut reflection, and become, I am persuaded, in innumerable cases, the germs of theories, and the connecting links between distant regions of thought, which might have otherwise continued indefinitely dissociated.

How far this Association has hitherto been instrumental in fulfilling the ends for which it was called into existence, can, however, be only imperfectly estimated from these considerations. Science, as it stands at present, is not merely advanced by speculation and thought; it stands in need of material appliances and means; its pursuit is costly, and to those who pursue it for its own sake, utterly unremunerative, however largely the community may benefit by its applications, and however successfully practical men may turn their own or others' discoveries to account. Hence arises a wide field for scientific utility in the application of pecuniary resources in aid of private research, and one in which assuredly this Association has not held back its hand. I have had the curiosity to cast up the sums which have been actually paid, or are now in immediate course of payment, on account of grants for scientific purposes by this Association since its last meeting at this place, and I find them to amount to not less than 11,167*l*. And when it is recollected that in no case is any portion of these grants applied to cover any personal expense, it will easily be seen how very large an amount of scientific activity has been brought into play by its exertions in this respect, to say nothing of the now very numerous occasions in which the attention and aid of Government has been effectually drawn to specific objects at our instance.

As regards the general progress of Science within the interval I have alluded to, it is far too wide a field for me now to enter upon, and it would be needless to do so in this assembly, scarcely a man of

which has not been actively employed in urging on the triumphant march of its chariot wheels, and felt in his own person the high excitement of success joined with that noble glow which is the result of companionship in honourable effort. May such ever be the prevalent feeling among us. True Science, like true Religion, is wide-embracing in its extent and aim. Let interests divide the worldly, and jealousies torment the envious! We breathe, or long to breathe, a purer empyrean. The common pursuit of Truth is of itself a brotherhood. In these our annual meetings, to which every corner of Britain —almost every nation in Europe sends forth as its representative some distinguished cultivator of some separate branch of knowledge; where, I would ask, in so vast a variety of pursuits, which seem to have hardly anything in common, are we to look for that acknowledged source of delight which draws us together and inspires us with a sense of unity? That astronomers should congregate to talk of stars and planets—chemists of atoms—geologists of strata—is natural enough; but what is there of *equal* mutual interest, *equally* connected with, and *equally* pervading all they are engaged upon, which causes their hearts to burn within them for mutual communication and unbosoming? Surely, were each of us to give utterance to all he feels, we should hear the Chemist, the Astronomer, the Physiologist, the Electrician, the Botanist, the Geologist, all with one accord, and each in the language of his own science, declaring not only the wonderful works of God disclosed by it, but the delight which their disclosure affords him, and the privilege he feels it to be to have aided in it. This is indeed a magnificent induction—a consilience there is no refusing. It leads us to look onward, through the long vista of time, with chastened but confident assurance that Science has still other and nobler work to do than any she has yet attempted; work, which before she is prepared to attempt, the minds of men must be prepared to *receive* the attempt—prepared, I mean, by an entire conviction of the wisdom of her views, the purity of her objects, and the faithfulness of her disciples.

Thursday, 19th June.

Section A.—MATHEMATICAL AND PHYSICAL SCIENCE.

The President, G. B. Airy, Astronomer Royal, not being in the Section when it opened, Prof. Forbes, one of the Vice-Presidents, took the chair.

Sir J. F. W. Herschel rose and stated, as a Report 'On the Nomenclature of Stars,' that the only reason for continuing this committee was to keep alive a small grant to pay for certain charts, the amount due for which, owing to the death of Mr. Baily, had not yet been ascertained.

Mr. Dent then addressed the Section on his proposed method of suspending a Ship's Compass. An account of this instrument was communicated to the Association at its last meeting in York. Mr. Dent now read extracts from a report of the working of this compass during six months at sea, as ordered by the Lords of the Admiralty, the amount of which was, that his compass was found "to be extremely sensitive, moving exactly and admirably with the ship's head, when the helm was put hard-a-port and hard-a-starboard: while the other compasses with which it was compared were always in arrear."

Dr. Lloyd asked whether Mr. Dent was aware, that the principle of his suspension bed had been successfully adopted by Mr. Fox, in an instrument which he had constructed for taking the inclination many years since.—Mr. Dent was aware that Mr. Fox had adopted that mode of suspending a dipping needle, for it was he himself who executed the instrument for Mr. Fox; but this was the first attempt, he believed, ever made to suspend the ordinary azimuth compass in that manner.

Dr. Scoresby described a large magnetic machine which he had constructed, with some results of its action. The principal part of the machine consists of two cases, or fasciculæ of magnetic bars, of unusually large dimensions, on principles which may be thus summarily stated:—1. That magnetic bars designed for large combinations, may be conveniently constructed of various pieces; that the separation of a long bar, say of three or four into several portions, is not disadvantageous in regard to power, and that the resulting power is similar,

whether in the combining of several series of short bars, the elementary bars be of the same or of unequal lengths.—2. That the relative powers of magnets, whether single or compound, when different in mass, but proportional in all their dimensions, are not in the ratio of the masses, the large masses being less strong proportionally then the smaller.—3. That whilst magnets of large dimensions are less powerful with respect to their masses, than small magnets to which they are exactly proportional in all their dimensions; and whilst the increase of the dimensions continually deteriorates from the energy due to the mass: yet magnets may be combined in such proportional dimensions with a constant increase of power *ad infinitum.* From this last result, it follows, that magnets indefinitely small must be indefinitely strong; and may indicate that the mutually attractive forces of the ultimate magnetic elements may be as strong as that by which the metallic elements are themselves combined. It must, also, be kept in mind, that the steel should be perfectly hard; and the elementary plates of the magnet should be made of steel, converted out of one or other of the very best qualities of common iron. All the conditions, with the exception of thinness, were attended to in the large magnet constructed by Dr. Scoresby. A magnet on this principle, of the size of the lower mast of a first-rate ship of war, would produce a deviation of nearly 1′ at the distance of a mile, and a sensible effect much beyond that. The electrical effects of Dr. Scoresby's magnet with a very imperfect armature were—it decomposed water, rapidly producing about one cubic inch of the gases a minute; with about sixty-five yards of coiled wire, the effervescence seemed as violent as during the action of dilute sulphuric acid or zinc. Copper was deposited from a solution of sulphate of copper at the rate of about 1·2 grain per minute. Shocks and scintillations were thrown out; and sparks were visible in daylight, and emitted audible sounds when the armature revolved, so slowly as one in sixteen seconds.

Prof. Forbes had little doubt that Dr. Scoresby could construct very powerful magnets; but he thought that as electro-magnets, so much more powerful, were so readily made, it was almost useless to incur the expense of the others—Mr. Roberts described a magnet which he had constructed some four or five years since—but as an account was published at the time in the 'Annals of Electricity,' we need not report it again.

'On the amount of rain which had fallen, with the different winds, at Toomavara, Limerick, during five consecutive years,' by the Rev. T. Knox.—Dr. Lloyd said, that he had already brought before the Section, at a former meeting, the results of these observations, while in progress; he had now the pleasure, at Mr. Knox's desire, of submitting the conclusions derived from the entire and completed series of five years' uninterrupted observations. After explaining briefly the principle of the instrument, by which the amount of rain with different winds is measured by Mr. Knox, and the mode in which the results are graphically represented, he proceeded to read the following remarks by Mr. Knox:—Taking the average monthly rain at three inches, the first six months of the year are below the average, the other six months above it. November and July are by far the two wettest months in the year; and in each, the greatest amount of rain is from SW. April is much the driest month; and there is nearly as much rain in it from the northern portion of the compass as from the southern. With regard to the gross amount which fell from each point in the entire year, that which fell from S., SW., and W., is much above the average; from the other points it is below it. If the polygon which characterizes the yearly rain be divided by a line running NE. and SW., then the rain at equal intervals on either side of this line is equal to all, but a fraction of an inch. This is the more remarkable, as these two points had been fixed on by Prof. Dove as being the points of greatest and least barometric pressure; that is to say, the wind being supposed at SW., any shift of it either towards S. or W. produces a rise of the barometer, and also any shift on either side of NE. a corresponding fall. Now, in the rain, the greatest amount is from SW., corresponding with the least height of the barometer; the least is from NE., where also the barometer is highest; and on either side of this line it varies regularly. For instance, the amounts from W. and S. are nearly equal, and both less than that from SW., NW. and SE., are also equal, but still less; and so on. There is one particular in which this separation of the gross amount of rain into the eight portions, as brought by different winds, may be useful;—viz. in ascertaining the respective specific gravities, and the amount of saline matter brought from each direction. This may be

useful in regard to agricultural matters. For instance, we could easily suppose a case of two portions of land, not many miles asunder, but on different sides of a high range of hills, getting different amounts of salt, from one being exposed to, and the others sheltered from that wind in which the greatest amount was found. But by this mode of collecting the rain, an accurate mode of estimating this is within our reach. To the question, namely, the amount of solid and gaseous matter brought in the rain from each direction, Mr. Knox, hopes on a future occasion to turn his attention.

The Tables which accompany this communication give the amount of the rain corresponding to each wind, for each separate month in the five years. The following are the yearly mean results, deduced from the whole series.

S.	SW.	W.	NW.	N.	NE.	E.	SE.	Total.
6·548	10·639	6·034	2·789	2·352	2·172	2·251	3·173	35·958

Mr. Dove said, that according to the hypothesis, that the meteorological phenomena of our latitudes may be explained by two currents, a polar and an equatorial, which mutually replace each other, a distinction is to be drawn between two kinds of rain, the one caused by refrigeration of the southern current coming into higher latitudes, the other when the southern current in the place of observation is overpowered and replaced by the northern. The first takes place when the vane is SW., the latter when the vane passes from SW. through W. to N., or from E. through S. to SW. The direction NE. indicates the polar stream without condensation. Hence it follows, that the quantity of rain is a maximum at SW., a minimum at NE., and is distributed symmetrically on either side.

The Bishop of Norwich expressed the satisfaction which he felt at hearing the communication of Dr. Lloyd, and his hopes that extended series of similar observations would soon be put on record. The great and anomalous varieties in the quantity of rain which fell in various localities would, he had no doubt, be found such as to create surprise. Thus, in London the quantity was only 23 inches annually, while in the neighbourhood of his residence it was no less than 33.—Sir John Herschel said that the importance of such observations when well conducted, could scarcely be over estimated; he believed the discrepancy in the amount of rain which fell in several parts

of England was still greater than had been stated by the Bishop of Norwich. If his memory did not deceive him—while in London the annual depth was only 23 inches, in Keswick it was no less than 60.—Mr. Roberts observed, that the discrepancies in the registries of rain-gauges were such as to render great caution necessary in drawing conclusions. It was now beginning to be understood that unless the rain-gauges were placed on a level with the earth, no indication would be obtained from them of the quantity which fell on the surface.—The Astronomer Royal said that there was something still unexplained as to the effect of the altitude at which the rain-gauge was placed, on the amount of rain received; while the quantity of rain received in the gauge on the top of the Observatory was less than that placed in the court below, yet a guage placed at the foot of Greenwich Hill, which was at a considerably lower level than either, received less rain.—Sir J. Herschel believed that the cold drop as it descended from above, received accessions from the vapour of the air through which it passed; and if this be the true account, then the explanation was complicated by the relative hygrometric states and temperatures of the several strata of air.

'On certain points in the Elliptic Polarization of Light, by reflexion from metallic surfaces,' by Prof. Powell. The object of this communication was supplementary to one given last year; since which time the author has extended his researches to some of the relations of the subject not before adverted to. The original plane of polarization being inclined 45° to that of incidence on metal in the lower degrees of ellipticity, *i. e.* at smaller incidences, the dislocated rings preserve the distinction of the dark and bright systems, which they lose, when the vibrations are absolutely circular; also at the position of the analyzer, intermediate to the rectangular positions, the coloured arcs assume a peculiar distorted appearance. A generalization of the formula, employed in the author's paper [*Phil. Trans.* 1843], so as to include all positions of the polarizer and analyzer, and assuming the component vibrations with general, or unequal, coefficients,—is necessary for explaining the last-mentioned phenomenon; while the former supplies the best means of directly observing the change in the virtual plane of polarization of the reflected ray, by means of the position necessary to be given to the analyzer,

in order to restore the same system of rings, as *e. g.* that for dark branches. These changes in general are analogous to, but not the same as, those in their reflexion from transparent bodies examined by Fresnel. But at the incidence for the maximum, as well as at that nearest the perpendicular, they are the same. At small incidences, in his former communication, the author mentioned that he had been led to suppose an anomaly in this respect, the arc appearing to deviate from 45°. But more recent and careful repetitions have shown that the results are really conformable to the law in this case. He has carried on a considerable series of observations of the change of plane, and of the ellipticity, at different incidences, and for various metals, &c. In regard to the maximum ellipticity, he has traced a relation to the constant arcs of restoration after two metallic reflexions, determined by Sir D. Brewster [*Phil. Trans.* 1830]. The change of plane cannot yet be explained by theory; though the empirical formulæ of Prof. Maccullagh appear to give a good representation of it; in the instance of steel, by introducing the data resulting from that investigation into the author's formula.

This paper gave rise to a discussion, in which Dr. Lloyd, Prof. Forbes, the Astronomer Royal, Mr. Challis, and Sir J. Herschel took part. It having been stated in the progress of this, that Sir J. Herschel had thrown out an opinion, that if the same amount of analytic skill had been expended upon the corpuscular theory of light as had been on the undulatory, perhaps more could be done with it than was at present believed.—Sir J. Herschel said he had not intended to bring any notions he might have casually thrown out on this point before the Section, because in truth they were in an indigested state; but as the subject had been mentioned, what he had said was, that physical differences of conditions could be conceived, which might perhaps furnish the analyst with equations depending on as few assumptions as those of the undulatory theory, by which perhaps an explanation of the phenomena on the corpuscular hypothesis might be worked out. Thus, for example, the individual particles of light might be possessed of poles, and be thrown off from the luminous body with revolving as well as progressive motions. While these motions were uninterfered with, all the particles would

proceed with their similar poles similarly arranged as at first, but interference of media might be conceived, which, by deranging the relative positions of the poles, or the particles of beams of light, moved so as to give the rays new physical characters. But he had not meant at all, when mentioning this view, to intimate that he had any settled opinion that a theory could be worked out for this or any other such view, by any means as complete as the undulatory theory.

A Thermometer Stand, by Mr. Lawson, and used at his Meteorological Observatory at Bath, was then described. 'The Meteorological Thermometer Stand' was stated to possess the following requisites: It can be placed on any eligible spot. Its four sides can and must be placed to face the cardinal points; commanding, therefore, a true north and south aspect. It can be visited on every side, and be free from all surrounding objects. The instruments or thermometers used, can be read off with great facility; and the whole will be at a known distance from the ground. Those instruments placed on the south face will have the meridian sun; and those on the north face will be always in the shade, in consequence of the projecting wings. It can be employed by any meteorologist wherever residing. It is of a determinate form, height and size. It is not costly, and may be constructed by any intelligent carpenter. It can be placed in any open situation. By the general adoption of this stand, instruments placed upon it will be all observed under similar circumstances, and can be compared with far less chance of error, than has hitherto been the case.—A model was exhibited, and a working plan and description distributed.

Dr. Lee bore testimony to the value and simplicity of the stand.

Section B.—CHEMISTRY AND MINERALOGY.

'On the Actinograph,' by Mr. Robert Hunt.—After referring to Daguerre's statement that the solar light, two or three hours before noon, was different in its chemical character from that which proceeded from the sun at equal times after it had crossed the meridian, the author proceeded to state from his own

researches, that he was satisfied that the amount of chemical power was not in direct ratio with the quantity of light, but that at different hours of the day, and at different seasons of the year, a remarkable variation may be found to exist. The peculiar conditions of plants in the morning and evening and the phenomena of hybernation were referred to variations in this chemical (actinic) power, and the processes of germination, of flowering, fruiting, and the autumnal decay of the leaf, shown to be, in all probability, dependent upon the same influence. This being the case, it became desirable that some *self-registering* means of remarking the changes in the condition of the sun's rays should be adopted. The actinograph is intended for this purpose. It consists of a cylinder of brass, upon which is placed a sheet of photographic paper, so prepared with the bromide of silver, that all the rays of the prismatic spectrum shall act upon it with equal intensity; over this is placed another cylinder, which is carried round by a clock movement once in the twenty-four hours. In this outer cylinder is a triangular opening, divided by bars into a hundred parts, the smallest part of the slit being one hundred times less than the largest. As this cylinder moves over the paper, it is of course exposed for different periods of time to the solar influence over different parts of the divisions; one portion being only exposed for one minute, whereas the largest opening admits of an exposure for one hundred minutes. Thus the greatest intensity of actinic power will produce, during the time of least exposure, the same effect as is produced by the weakest radiations during the period of prolonged exposure. The papers are removed every night and divided into twenty-four parts, and we have hence an exact measurer of the amount of chemical power exerted during every hour of daylight; and as the results may be numerically registered, and the uncertain effects of fixing thus removed, we procure with attention an accurate record for any period of time. This instrument is a modification of one devised by Sir John Herschel, with some improvements suggested by Mr. Jordan. Mr. Hunt stated, that circumstances had prevented his doing more than make a few trials of the apparatus, but that he hoped after the meeting to fix it, and use the actinograph for constant registration.

Prof. Bunsen and Dr. Lyon Playfair (first part of the Report 'On the Gases from Furnaces'), 'On the eudiometric method of analysis employed in the inquiries on the Manufacture of Iron, and the Gases evolved in the distillation of Coal.' The authors described in the first instance their method of collecting the gases from the furnaces, which they had succeeded in doing from every part of the iron furnaces, and this in England, Norway, and Sweden. The imperfect state of eudiometry was dwelt on, and the mode adopted by the authors described; but as the details necessarily involve a number of purely chemical questions, we shall only refer to the more interesting facts. By the improved method, the condition of the atmosphere was first ascertained, and the average of many experiments gave as its composition—

Nitrogen, ...	70·09
Oxygen, ...	20·91

which is nearly the result obtained by other eminent chemists. The analyses of the various carburetted hydrogens, collected from coal and coke, were next detailed, and many improvements named, particularly that the per-chloride of antimony completely absorbed all the carburetted hydrogens, whether the fire-damp, or the olefiant gas, allowing the carbonic oxide and carbonic acid to pass freely, which were afterwards collected and ascertained in the usual manner. The gases proceeding from iron furnaces were found to be—

1. Nitrogen.
2. Ammonia.
3. Light carburetted hydrogen.
4. Olefiant gas.
5. Carbonic oxide.
6. Carbonic acid.
7. Carburetted hydrogen of unknown composition.
8. Aqueous vapour.
9. Hydrogen.
10. Sulphuretted hydrogen.

The gasification of coal in the furnaces takes place in two different points, in the first instance during the distillation of the coal and the formation of coke; and secondly, when the coke undergoes the process of combustion. This result was uniformly observed, and the

authors verified it by subsequent experiments on artificial arrangements. The analysis of coal by dry distillation gave—

Coke,	68·92
Tar,	12·23
Water,	7·61
Light carb. hydrogen,	7·04
Carbonic oxide,	1·13
Carbonic acid,	1·07
Olefiant gas,	0·75
Sulphuretted hydrogen,	0·75
Hydrogen,	0·50
Ammonia,	0·17
Nitrogen,	0·03
Condensed hydro-carbon,	00·0
	100·00

In the second part of the Report the practical application will be detailed.

'On Malacca Guano,' by Dr. Canter.—This communication described a peculiar substance, of which recently samples have been sent to England. It was stated to be inferior to both the African and the Peruvian, and curiously enough to consist almost entirely of the legs and other indigestible parts of beetles.

Mr. Pearsall made some observations 'On Masses of Salt discovered in the lowest portions of Guano on the Island of Ichaboe.'—The salt was transparent and colourless, very soluble in water, and contained phosphoric acid, soda and ammonia, and a trace of some organic matter, which became carbonaceous at a high temperature. The salt, therefore, appears to be a microcosmic salt, phosphate of soda, and ammonia.

Friday.

Prof. Daubeny 'On the Chemical Principles involved in the Rotation of Crops.'—Prof. Daubeny made some remarks on the chemical principles involved in the rotation of crops, stating the conclusions which he had deduced from a series of experiments carried on within the Botanic Garden at Oxford, and intended to ascertain the rate of diminution in the produce of several plots of ground that had been sown for ten years, either continuously with the same, or successively with different crops, in either case without the addition

of manure throughout the course of the trials. He stated that although, as might have been anticipated, a diminution in the latter years' produce took place both in the permanent and in the shifting crops, and a smaller average amount was obtained in the former than in the latter, yet that after the expiration of the whole period the ground still continued unexhausted; and that an analysis of it showed it still to contain sufficient of the phosphates to supply materials for 19 crops of barley, sufficient of potash for 15, and sufficient of soda for 45. The actual diminution then of produce during the latter years he attributed to the circumstance of these ingredients not being in a soluble condition, it being found that from the soil so long drawn upon, water impregnated with carbonic acid took up much less of the above ingredients, than it did from the same that had not been so cropped, and but recently manured. The greater diminution in the permanent than in the shifting crop he attributed to the circumstance of the latter being supplied with a larger amount of organic matter, derived from the fallow crop intercalated, owing to which the plants would be more fully developed through the influence of the carbonic acid and ammonia, which would be imparted to it by the decomposition of the *humus*. He pointed out, how the mere introduction of healthy plants into a soil might aid in rendering the phosphates and alkaline salts, locked up within the latter, more speedily soluble, and hence inferred that a larger amount of these substances might be extracted, where the plants were stimulated into activity by the presence of decomposing organic matter. He also was led to inquire whether, in the event of a scantier supply of one of the alkalies or of the earths than was common, a plant would substitute, *ad libitum*, another which might be presented to it in greater abundance. To determine this, he obtained from Mr. Way, late assistant to Prof. Graham, an analysis of three samples of six different kinds of crop—viz. potatoes, barley, turnips, hemp, flax, and beans; one sample being, that cultivated for ten successive years in the same ground without manure; the second, from a similar plot which had grown different crops for the same period without manure; the third, from a plot in a contiguous part of the garden which had been recently manured. From the results obtained, it would appear that the aggregate amount of *bases*, in the three samples, was about the same; but

the proportion of these bases one to the other varied considerably, a circumstance at first sight appearing to confirm the theory of substitution. The author however conceives that this may be explained, by supposing a different degree of developement of the several parts or proximate principles in the respective samples, as he finds a great discrepancy in the amount of phosphoric acid in gluten and in starch, and thinks it probable that the same diversity may extend to other of the principles contained in each plant. That potass is better adapted for the organization of a plant than soda, seems to follow from the circumstance, that whilst the soil usually contained an excess of soda, the plant always was most rich in potass. The author, therefore, in accordance with the views of Liebig, throws out as a conjecture, that the soda found in the ash may be that circulating through the vegetable tissue, and contained on the top, whilst the potash is actually assimilated, and constitutes a part of the vegetable tissue. The former, as Liebig supposes, may be useful in conveying carbonic acid to the plant, but cannot be substituted for potass, at least without injury to its healthy condition. It appears also, from the analyses referred to, that land plants have not the power of decomposing common salt, so that this substance cannot, as has been supposed, be serviceable to vegetation, by supplying it with alkali. We may also infer, that it does not follow, because a soil is benefited by manuring, that it is destitute of the ingredients which the manure supplies, since it may happen that these ingredients are present in the soil in an insoluble, and therefore not an available condition. Chemical and mechanical means may no doubt be effectual in bringing into a soluble condition the phosphates and alkaline salts thus locked up within the soil, but as this is brought about by Nature herself, we are counteracting her beneficial effects when we waste the products of these operations, ready prepared for our hands, as is done in suffering to run to waste the various excrementitious matters which are placed at our disposal. The analyses given may also show, from their great discrepancy with those of Sprengel, the importance of that investigation of the constituents of the ashes of plants, now about to be undertaken under the auspices of the Royal Agricultural Society. The author also conceived that the line of research which he had pursued might be

useful as an illustration of that system of Scientific Book-keeping, which he had proposed at a former meeting of the Association, at once as an useful exercise to the agricultural student, and as a means of introducing greater precision into the conduct of our experiments in such subjects.

'On the Ashes of Wheat,' by W. Sharp.—Mr. Sharp noticed that the amount of the ashes of wheat was given from Sprengel as 1·177 per cent., whereas Sprengel himself (page 446, vol. 2, of his 'Chemie für Landwirthe,' &c,) states it to be 1·777; Dr. Daubeny, on the other hand, gives Sprengel's analysis as 2·137 ;—both on the supposition of a misprint in Sprengel's book. This led Mr. Sharp to undertake some experiments in order to ascertain the truth; and one suggestion arising out of another, about a hundred experiments were performed, with great care, on varieties of red and white wheat, grown on different soils and climates in England, Germany, Sweden, Poland, Holland, and Saxony. Ultimately, answers to the following questions were sought and apparently found :—1st. What is the average amount of inorganic matter in the grain of wheat? From 1·5 to 1·75 per cent.—2nd. What is the difference in the result obtained from the combustion of wheat which has been previously dried at different temperatures? A great number of experiments were made by drying at temperatures of 245°, 260°, and 60°, and the difference of results was shown to be considerable.—3rd. Can any temperature be recommended as the one to be preferred, at which the materials for these and similar experiments should be dried? The result of the experiments alluded to in the previous answer was in favour of the temparature of 60°.—4th. Can any chemical preparation be added to the substances experimented upon, before or during the combustion, which will facilitate the otherwise tedious process? Several substances were tried, particularly nitric acid, but they all failed to give satisfactory results. The per-centage left by nitric acid was always less, but not uniformly less, than it ought to have been.—5th. Does the quantity of inorganic matter bear any relative proportion to the specific gravity of the grain,—that is, to its weight per bushel? The experiments show that a steady *inverse ratio* is maintained between the proportionate weight per bushel and the amount of ashes. Wheat weighing 64lb. per bushel yields 1·5 per cent.; and this

amount gradually increases, till wheat weighing 58lb. per bushel gives 1.75 per cent.—6th. The practical question then follows :—How much inorganic matter is removed from the soil of an acre of land by the grain of a crop of wheat? The answer is, one pound per bushel.

'Analyses of Three Species of Fucus,' by E. G. Schweitzer.—These analyses were undertaken with a view to ascertain the causes which render one kind of fuci beneficial as a manure, whilst other kinds do not succeed. It was found that in the *Laminaria saccharina* the alkaline carbonates predominated, whilst in the *Fucus vesiculosus* and *Fucus serratus* there was an excess of the sulphates; and in the Laminaria, potash is found in larger quantities than soda, whilst the contrary is the case with the Fuci. The quantity of iodine in Laminaria was also greater than in the other two. Some experiments were tried to ascertain if the Laminaria exhaled iodine under the influence of sunshine, but no such exhalation could be detected. The analyses were exceedingly minute, giving twelve and thirteen constituents determined.

Prof. Johnston made some remarks on the imperfections of our knowledge of the chemical principles of Rotation, the difficulty having been the length of time required for a full investigation of the subject. He objected to the opinion expressed by some chemists, that any crop may be grown on the same soil for any length of time, by the application of manures, the quality of which were to be decided by analysis. In addition to chemical considerations, the physical conditions of the soil are to be taken into account. Several points were shown to require strict attention, particularly the structure of the plant itself, and the character of its root, which he had observed to vary with the conditions of the soil.

'On the Voltaic Reduction of Alloys,' by C. V. Walker.—This communication was intended to explain the methods by which the author has succeeded in throwing down metallic alloys from compound solutions by the action of galvanic electricity. The process adopted, is to prepare a strong solution of cyanide of potassium, and commence electrolyzing it, by means of a copper anode; as soon as copper begins to be dissolved, the copper anode is removed, and its place supplied with one of zinc; after the action has continued for

some little time, brass will be liberated on the cathode. The solution is now ready for use, and is operated upon by two or three Daniell's cells, and with a brass anode. By similar means alloys of gold and copper, or gold and silver, may be deposited. The author reasons, that true brass is a definite chemical compound; and states—It appears possible that the anode, which is a brass of commerce, is a true alloy, plus an excess of zinc; that the solution it produces is a mixed solution, which consists of the potassio-cyanide of brass and the potassio-cyanide of zinc. This solution is very readily decomposable; it is therefore necessary to prepare it a short time previously to its use. Many specimens were exhibited of copper and other metals coated with brass. The author makes some remarks on the theory of the action; and concludes by stating that it will be quite possible to determine, within certain limits, the character of the alloy that shall present itself, and that we may be enabled to throw down gold and silver according to standard.

Dr. Lyon Playfair read a paper on Atomic Volumes, of which we have already given a report in our notice of the Chemical Society [see *ante*, p. 591.]

Thursday.

Section C.—GEOLOGY.

'On the Geology of the Vicinity of Cambridge,' by the President.

Prof. Sedgwick commenced by pointing out, on a geological map, the general direction of the oolitic and cretaceous formations of Cambridgeshire and the adjoining countries. He then proceeded to describe their subdivision and fossil remains, commencing with the chalk, which forms an elevated tract eastward of the Bedford Level, occasionally swelling into low hills such as those of Gog and Magog, and containing a variety of fossils, especially at Cherry Hinton. Below these hills commences a flat country stretching westward for many miles, forming extensive tracts of marsh land and peat bogs; a portion of this nearest the chalk, and slightly swelling above the dead level of the country beyond it, is occupied by the gault clay, which may be seen in the pits near the Castle, and is met with beneath the chalk, wherever that formation has been sunk through. South of Cambridge it occupies a bay in the outline of the chalk district, in

which are the two small outlying masses of chalk of Madingly and Barton. Between the chalk and gault is a stratum, not more than a few inches thick, of upper greensand full of black nodules, containing 50 or 60 per cent. of phosphate of lime, and many shells. The gault is about 150 feet thick, and formerly when a boring was made through it, the water used to rise above the surface to a sufficient height for the construction of fountains, but latterly so many borings have been made that the waterhead is lowered. This supply of water is afforded by a bed of sand beneath the gault, which comes to the surface about seven miles from Cambridge, on the Ely road, and is also met with, parallel to the chalk hills, for a considerable distance; its outcrop may be distinguished by the churches and monastic buildings placed on it, since it affords at the same time dry building ground, and a constant supply of water. In this district it contains scarcely any fossils. This lower greensand, as it is called, as well as the gault and chalk, inclines slightly to the east, and it is this inclination or dip that throws up the water in the Cambridge wells and fountains by hydrostatic pressure. Below the sand commences the great clay of the fen district, the upper part abounding with *Ostrea deltoidea* and the Saurian remains of the Kimmeridge clay, but passing imperceptibly into the Oxford clay, without any intervening coralline formation such as separates them at Weymouth, Oxford and elsewhere in the south of England. Here it is only seen at one place, on the river Cam, at Upware, nine miles below Cambridge, where it extends for about a mile, and appears to have formed a sort of pivot on which the other rocks of the country are thrown into a saddle shape. The surface is in many places covered up by masses of gravel and clay belonging to a more recent period, the clay being part of the great boulder formation or "till," composed of drifted materials brought, as the President supposed, by a rush of water from the north-west over the fen districts, and also containing blocks of stone derived from a more distant source. It is unstratified and occupies plateaux on the hills, the valleys having been mostly formed since its deposition. The *red gravel* is supposed to be newer than the "till," and contains abundant remains of the elephant, rhinoceros, and other extinct animals. In addition to these two superficial deposits are the great modern formations of peat bog, which have

afforded many remains of animals long since extinct in this country. The whole thickness of the peat is annually removed in many places, laying bare a great extent of the surface of the subjacent clay, and upon this have been found remains of the Irish elk, beaver, wolf, bear, and bones of the badger, otter, roebuck and red deer in abundance. The President illustrated his observations by sections, of which the most remarkable were two in the neighbourhood of Ely, exhibiting a dislocation of the strata by which the chalk on one side of the line of gault was brought to the level of the lower greensand on the other, from which both chalk and gault had been removed.

In reply to a question from Capt. Ibbetson, the President stated that the thickness of the boulder clays was 200 feet near Caxton, and that the displacement of the strata seen in the great clay-pit near Ely amounted to at least 150 feet.

Mr. Murchison read a letter from Mr. Ferdinand Oswald, of Oels, respecting the occurrence of Silurian rocks at the villages of Ober and Neu Schmollen, near Breslau, in Silesia, and covering an area of about eight English square miles.—Mr. Murchison considered this an interesting discovery, as throughout Germany the older rocks belonged almost exclusively to the carboniferous or Devonian systems, and Prague was the only place from which many Silurian fossils had been derived. It was a question whether this was really a little island of Silurian rocks *in situ*, or whether it was only a part of the boulder formation, which often contained Silurian rocks derived from Scandinavia and Russia. In Mr. Oswald's copious list of fossils were mentioned *Illænus crassicauda*, *Sphæronites*, and other characteristic lower Silurian fossils, together with almost all the best-marked corals of Wenlock and Dudley, a remarkable and unexpected mixture of the fossils of two very different periods.

Baron Leopold von Buch observed, that before this was admitted, it would be necessary to see the place.—Mr. Phillips remarked that there were many unsatisfied problems in geology, particularly as to what had been the probable physical conditions which had determined the uniformity of the types of organic life over great areas, accompanied as it was by considerable diversity of local association. Mr. Murchison's Silurian system presented the same general aspect in many distant parts of the world, but even in England there were

detached Silurian districts presenting particular changes and modifications, arising from difference of depth, and the variety of currents, and chemical combinations in the sea in which they were formed; in consequence of this variety of physical condition there was a corresponding diversity in the traces of organic life in each situation. The particular circumstances which had given the remarkable succession of organic life in Shropshire had not obtained in Pembroke, where the same series of organic forms had continued from the lower to the upper Silurian period.—The President said, he was convinced that future examinations would confirm, not shake, his confidence in the general accuracy of the results which had been obtained by geological investigation. The present question was only whether there should be one chapter instead of two—not whether they should break up the great authentic facts of their history. In the north of England and in North Wales the division between the upper and lower Silurian rocks was as distinctly marked as at Malvern and in Shropshire; but the subdivisions did not exist, because the physical conditions under which each was developed were altogether different. It was probable that *species* would be found to have a wider range than was at first supposed, but as to the corals of the Silurian system, the Wenlock species certainly did not make their appearance in the calcareous beds of the Caradoc series where similar conditions prevailed. He asserted that in no instance had general conclusions been shaken by subsequent observations; and he believed that whatever alterations and minute adjustments might take place, the great fundamental principles of the science and the grand subdivisions already introduced into its history would not be upset, but extended and confirmed by future inquiry. Sir H. De la Beche confirmed Mr. Phillips's remarks upon Pembrokeshire, stating that in Marloe's Bay, the Ordnance Surveyors had measured each bed and marked all the fossils that occurred in each; when their lists were published it would be seen that many species continued from the commencement to the end of the Silurian series, because at that spot there was no change of mineral condition.—Dr. Buckland wished to correct a false impression not uncommon among novices, who hear only debates and conflicts in disputable points in geology, that there is nothing certain in the conclusions of that science; and he wished it

to be understood, that from the moment when organic remains were appealed to as the true ground of comparison between the rocks of different ages and in different countries, there had been no difference of opinion amongst geologists upon the broad principles of their science.

Mr. Murchison announced the general results obtained by M. Göppert from the formation of a tabular view of the fossil plants which had been discovered up to the present time all over the Globe. Mr. Murchison stated that this general *résumé* of the fossil Flora of the Globe would be published by MM. Göppert and Bronn, in a similar form to Mr. Morris's British Catalogue; the number of fossil plants known to M. Adolphe Brongniart in 1836 had been 527, in the new list they amounted to 1,792; and as in the 80,000 plants now known to exist in different parts of the Globe, a large proportion consists of fucoids and fungi, which would disappear in the process of fossilization, it would be seen that the total number of known fossil species bore a considerable proportion to those now existing. Their numerical distribution in the different rocks is stated by M. Göppert to be as follows :—

Palæozoic,	52
Carboniferous,	819
Permian,	58
Triassic,	86
Oolitic,	234
Wealden,	16
Cretaceous,	62
Tertiary,	454
Unknown,	11
Total,	1,792

From this table it appeared, that the carboniferous group contained more than half the known species of fossil plants, a remarkable circumstance when it was considered that the great herbivorous land quadrupeds had no existence before the tertiary period. The small number of plants in the cretaceous system was, no doubt, owing to the depth of the sea in which those formations were deposited.

Mr. Greenough stated that an enumeration of all the known fossil plants had been published by M. Keferstein, arranged in the same

manner as that proposed by M. Göppert. He warned geologists against drawing any inferences from the numerical proportion of plants in different strata, since their preservation would depend more upon the nature of their matrix, the depth of the sea, and other circumstances, particularly the nature of the plants themselves; for it appeared from Dr. Lindley's experiment that some plants entirely disappeared in water, whilst others remained for a considerable time.—Mr. C. J. Bunbury said, that too much importance had been attached to Dr. Lindley's experiment; the preservation of plants in water was stated to depend upon the nature of their tissue and consistency, the more robust plants best resisting decomposition; yet the *Equisetum hyemale,* a plant containing an unusually large proportion of silex, disappeared entirely. In this experiment the large and robust ferns were amongst those plants which best resisted the action of water, but in the coal measures many extremely well preserved species resembled in their consistency the recent Trichomanes and Hymenophyllum, which are as delicate and fragile as mosses. Again, it was evident that the plants preserved in the coal measures had not merely been subjected to maceration in water as in Dr. Lindley's experiment, but also to pressure, for the largest stems of Sigillaria and Lepidodendron were pressed flat, and it was probable that vegetable matter could not be converted into perfect coal without pressure, otherwise the volatile constituents would have escaped. The proportion of fossil plants in each formation must depend on other circumstances besides their power of resisting decomposition, and the experiment required to be made over again, with various modifications. It was a singular circumstance that no mosses had been discovered in the older rocks, and only two species in the tertiary; for although the terrestrial species employed in Lindley's experiment disappeared entirely, this would scarcely happen to the numerous species which live habitually in water and marshy situations.

'On the Structure and Relations of Cornulites and other allied Silurian Fossils,' by Mr. J. W. Salter.—The singular fossil named *Cornulites serpularius,* is well known as characteristic of the Silurian rocks of Gothland, Britain, and North America and its affinities have been the subject of much conjecture. Mr. Salter's investigations proved that it differed essentially from any crinoidal animal or coral,

and was most probably an ancient form of the Serpulinæ. From a similarity of structure in the Tentaculites, another abundant fossil of the Silurian rocks, Mr. Salter is disposed to refer it to the same group with Cornulites.

Section D.—ZOOLOGY AND BOTANY.

Dr. Richardson read a Report, which had been called for by the Section, 'On the Ichthyology of China.' Till within a recent period, little was known of Chinese fishes. Linnæus was acquainted with about a score of Japanese fish; and a few were afterwards added to the list by Langsdorff, who accompanied the Russian admiral, Knesenstiern, in his voyage to the Isles of Japan and the South Sea. With these exceptions, the fish of the eastern coasts of Asia, from the Sea of Ochotsic down to Cochin China, were, till very recently, known to European naturalists only from Chinese and Japanese drawings, several collections of which are to be found in the Paris and British libraries. Yet the fish of the coasts of China are abundant, and the fisheries extensive and important. Materials for the description of these fishes were not wanting. Mr. John Reeves had beautiful coloured drawings, mostly of the size of life, made of no fewer than 340 species of fish which are brought to the markets in Canton. Copies of these drawings now exist in the British Museum. Some fishes have been recently sent from Chusan; other Chinese fishes have been described in the account of the voyage of the Sulphur. A collection of 100 fishes made at Canton, exists in the Museum of the Philosophical Society of Cambridge. From these and other recent sources, the present report was drawn up. The author concluded from his researches that the existence of chains of islands or of continuous coast having an east and west tendency promotes the range of a species or of a group of species. Thus, to take the intertropical zone of the ocean, we find very many fish common to the Red Sea, the coasts of Madagascar, the Mauritius, the Indian Ocean, the southern parts of China, the Philippines, the whole Malay Archipelago, the north coasts of Australia, and the entire range of Polynesia, including the Sandwich Islands. In the generic forms of its fresh-water fish, China agrees closely with the peninsula of India. If we could suppose that the extensive belt

above alluded to, enclosing more than two-thirds of the circumference of the Globe, to be suddenly elevated, we should find the remains of fish scattered over it to be everywhere very nearly alike,—the species having a local distribution being comparatively few and unimportant. These spoils of fish would, of course, in accordance with the observation of Prof. E. Forbes, be associated with very various assemblages of mollusks and other marine animals, according to the depth at which the deposit took place. This was an important fact for the science of Geology.

Mr. W. Thompson expressed his surprise at the number and apparent completeness of the lists given by Dr. Richardson.—Mr. Ogilby thought the views of the reporter of the greatest importance in a geological point of view. It opened up a new field for both zoological and palæontological inquiry. As far as the geographical distribution of fishes was concerned, those of the fresh-water offered the greatest facility for study, as they could not pass from one point to another, on account of the ocean.—The Bishop of Norwich related several facts, showing that the spawn of fishes may be conveyed from one country to another over the sea. He knew an instance in which the ova of the pike were deposited in the thatch of a cottage, and after having remained there for years, on the thatch being thrown into a dry ditch, which afterwards became filled with rain, young pike appeared.—Dr. Richardson stated that, in many zones of the earth, the same fishes appeared in the same parallels. It was not so over the Atlantic, where a deep sea intervened. The two sides of the Atlantic contained different fishes.

The Secretary, Mr. Wollaston, read a paper 'On the Periodical Appearance of certain Birds in North Wales.'

Dr. Macdonald read a paper 'On the Unity of Organization as exhibited in the Skeletons of Animals.'

The Secretary read a paper from Mr. Bonomi, 'On a gigantic Bird sculptured on the Tomb of an Officer of the Household of Pharaoh.' "In the gallery of organic remains in the British Museum are two large slabs of the new red sandstone formation, on which are impressed the footsteps or tracts of birds of various sizes, apparently of the stork species. These geological specimens were obtained through the agency of Dr. Mantell from Dr. Deane of Massachusetts,

by whom they were discovered in a quarry near Turner's Falls. There have also been discovered by Capt. Flinders, on the south coast of New Holland, in King George's Bay, some very large nests measuring twenty-six feet in circumference, and thirty-two inches in height; resembling, in dimensions, some that are described by Capt. Cook, as seen by him on the north-east coast of the same island, about 15° south latitude. It would appear, by some communications made to the editor of the *Athenæum*, that Prof. Hitchcock of Massachusetts had suggested that these colossal nests belonged to the Moa, or gigantic bird of New Zealand, of which several species have been determined by Prof. Owen, from bones sent to him from New Zealand, where the race is now extinct, but possibly at the present time inhabiting the warmer climate of New Holland, in which place both Capt. Cook, and recently Capt. Flinders, discovered these large nests. Between the years 1821 and 1823, Mr. James Burton discovered on the west coast or Egyptian side of the Red Sea, opposite the peninsula of Mount Sinai, at a place called Gebel Ezzeit, where for a considerable distance, the margin of the sea is inaccessible from the Desert, three colossal nests within the space of one mile. These nests were not in an equal state of preservation; but, from one more perfect than the others, he judged them to be about fifteen feet in height, or, as he observed, the height of a camel and its rider. These nests were composed of a mass of heterogeneous materials, piled up in the form of a cone, and sufficiently well put together to insure adequate solidity. The diameter of the cone at its base was estimated as nearly equal to its height, and the apex, which terminated in a slight concavity, measured about two feet six inches, or three feet in diameter. The materials of which the great mass was composed, were sticks and weeds, fragments of wreck, and the bones of fishes; but in one was found the thorax of a man, a silver watch made by George Prior, a London watchmaker of the last century, celebrated throughout the East, and in the nest or basin at the apex of the cone, some pieces of woollen cloth and an old shoe. That these nests had been but recently constructed was sufficiently evident from the shoe and watch of the shipwrecked pilgrim, whose tattered clothes and whitened bones were found at no great distance; but of what genus or species had been the architect and occupant of the struc-

ture Mr. Burton could not, from his own observation, determine. From the accounts of the Arabs, however, it was presumed that these nests had been occupied by remarkable large birds of the stork kind, which had deserted the coast but a short time previous to Mr. Burton's visit. To these facts," said Mr. Bonomi, "I beg to add the following remarks:—Among the most ancient records of the primeval civilization of the human race that have come down to us, there is described, in the language the most universally intelligible, a gigantic stork bearing, with respect to a man of ordinary dimensions, the proportions exhibited in the drawing before you, which is faithfully copied from the original document. It is a bird of white plumage, straight and large beak, long feathers in the tail; the male bird has a tuft at the back of the head, and another at the breast: its habits apparently gregarious. This very remarkable painted basso-relievo is sculptured on the wall, in the tomb of an officer of the household of Pharaoh Shufu (the Suphis of the Greeks), a monarch of the fourth dynasty, who reigned over Egypt, while yet a great part of the Delta was intersected by lakes overgrown with the papyrus,—while yet the smaller ramifications of the parent stream were inhabited by the crocodile and hippopotamus,—while yet, as it would seem, that favoured land had not been visited by calamity, nor the arts of peace disturbed by war, so the sculpture in these tombs intimate, for their is neither horse nor instrument of war in any one of these tombs. At that period, the period of the building of the Great Pyramid, which, according to some writers on Egyptian matters, was in the year 2100 B. C. which, on good authority, is the 240th year of the Deluge, this gigantic stork was an inhabitant of the Delta, or its immediate vicinity; for as these very interesting documents relate, it was occasionally entrapped by the peasantry of the Delta, and brought with other wild animals as matters of curiosity to the great landholders or farmers of the products of the Nile,—of which circumstance this painted sculpture is a representation, the catching of fish and birds, which in these days occupied a large portion of the inhabitants. The birds and fish were salted. That this document gives no exaggerated account of the bird, may be presumed from the just proportion that the quadrupeds, in the same picture, bear to the men who are leading them; and, from the absence of any repre-

sentation of these birds in the less ancient monuments of Egypt, it may also be reasonably conjectured, they disappeared soon after the period of the erection of these tombs. With respect to the relation these facts bear to each other, I beg to remark that the colossal nests of Capts. Cook and Flinders, and also those of Mr. James Burton, were all on the sea shore, and all of those about an equal distance from the equator. But whether the Egyptian birds, as described in those very ancient sculptures, bear any analogy to those recorded in the last pages of the great stone book of Nature (the new red sandstone formation), or whether they bear analogy to any of the species determined by Prof. Owen from the New Zealand fossils, I am not qualified to say, nor is it indeed the object of this paper to discuss; the intention of which being rather to bring together these facts, and to associate them with that recorded at Gezah, in order to call the attention of those who have opportunity of making further research into this interesting matter."

Mr. H. Strickland remarked, that the instances of gigantic birds, both recent and fossil, enumerated by M. Bonomi, though interesting in themselves, had little or no mutual connexion. The artists of ancient Egypt were wont to set the laws of perspective and proportion at defiance, so that the fact of the birds, here represented, being taller than the men who were leading them by no means implied the former existence of colossal birds in Egypt. Indeed, in this very painting the foot of a human figure is introduced, probably that of a prince or hero, whose proportions are as much larger than those of the birds in question as the other human figures are smaller. He considered the birds here figured to be either storks, or demoiselle cranes, or egrets, all of which are common in Egypt. The gigantic nests found by Mr. Burton on the coast of the Red Sea deserved further examination; but the size of a nest by no means implied that the bird which formed it was large also, for the Australian Megapodius, a bird not larger than a fowl, makes a nest of enormous proportions.

Mr. Thompson read a communication, from Messrs. Alder and Hancock, 'On a New Genus of *Mollusca Nudibranchiata*.' This new genus is founded on the *Tritonia arborescens* of authors and its allies, which are distinguished from the true Tritonia (*T. Hombergii*,

&c.) by the form of their tentacula, and the free, arborescent nature of their branchiæ. These characters alone induced the authors to consider them generically distinct, before they had an opportunity of examining their internal structure, in which such important differences in the digestive organs were exhibited as to show that this new genus—for which the name of Dendronotus is proposed—should be removed from the family Dorididæ to that of Eolididæ, to be placed first in order, as the connecting link between these two families.

The paper was illustrated by drawings from the work by Messrs. Alder and Hancock on the British Nudibranchiate Mollusca just published by the Ray Society.

Prof. Allman remarked, that this paper was important, as it more clearly than ever demonstrated the errors into which M. de Quatrefages had fallen with regard to this family.

'On the Cilia and Ciliary Currents of the Oyster,' by the Rev. J. B. Reade.—The author stated, that in a microscopic investigation of Infusoria, which had for some years occupied his attention, he had been led particularly to notice the beautiful contrivance by which many species, when not exerting their powers of locomotion, are supplied with food. When they are examined under the microscope by such an arrangement of transmitted light as makes the Infusoria luminous points on a perfectly dark field, it is immediately seen that the action of the cilia attached to their tentacular, produces a strong current in the water, and hereby a countless number of minute living organisms is brought within the influence of the cilia, and a sufficient supply is selected for food. Thus, with respect to Infusoria, it is a known fact, that the absence of the prehensile organs possessed by larger creatures is compensated by this delicate, but efficient ciliary apparatus. It is also a fact equally well known, that the lips of the oyster, which surround the orifice of the alimentary canal, are, in the same manner, fringed with cilia; and that these cilia of the oyster, as of Infusoria, equally cause currents in the water. But it has never been suggested and proved by any naturalist that the proper office of the cilia of oysters is to bring to these acephalous mollusks that food which they have no power to follow or to seize. Such, however, without doubt, is the case; and, accordingly, an examination of the contents of the stomachs of

oysters discovers to us their infusorial food; and, after undergoing the process of digestion in the stomach, the siliceous shields of these Infusoria, deprived of their organic and carbonaceous integuments, are ejected as effete matter. In a paper communicated last year to the Microscopical Society of London, on animals of the chalk still found in a living state in the stomachs of oysters, these Infusoria were described and enumerated. The apparent identity existing between these recent living Infusoria and the fossil, makes the inquiry of considerable interest to the geologist; for the addition of this connecting link to the chain of organized beings extends a continuous line of the same organic structure from the secondary formation to the tertiary, and seems to preclude the supposition of Prof. Phillips, that below the tertiary formation are no recent species. Whether or not this conclusion be admitted, it is a fact, ascertained by pursuing this inquiry, that the oysters and other bivalves, which are innumerable in the Kimmeridge clay, lived, like recent oysters, upon Infusoria; and, consequently the conclusion is unavoidable, that the Kimmeridge clay, like the chalk, contains a considerable per-centage of these minute and indestructible bodies which the microscope discovers in it, and is not the mere comminuted detritus of more ancient and unorganized materials. With these facts established, we may still further conclude, from analogy, that a similar ciliary apparatus, and similar infusorial food were common to the still earlier bivalves in the seas of the transition formation; and we may then ask—What right have we, in the absence of a careful microscopic examination of still earlier rocks, to deny the possibility of any portion of their mass being due to the agency of siliceous Infusoria?

SECTION E.—MEDICAL SCIENCE.

This Section met, and adjourned.

SECTION F.—STATISTICS.

Mr. J. Heywood read a paper 'On the University Statistics of Germany.' He stated that the number of professors is about 1,500, and of students 15,000; and particularly directed attention to the University of Göttingen, where the numbers have fallen from 2,000 to about 600, in consequence of the conduct of the King of Hanover. On a comparison of the courses of study, it appeared that those of the Catholic universities were disproportionately onerous, about five hours every day being given to prayers and religious duties. The origin of duelling among the German students was ascribed to their being permitted to wear swords as a badge of gentility; but the duels were shown to be generally of a harmless nature.

Mr. Heywood also read a paper 'On the Comparative number of Degrees taken at Cambridge in the Seventeenth and Nineteenth Centuries.' The result showed that there had not been any material increase in the course of two centuries,—the average being about 320 annually at each period. Nearly one-third of the students leave the university without taking a degree. Conversation ensued, and it was suggested that the more mature age at which students now enter was one cause why graduations have not increased in proportion to the population. Prof. Pryme observed that it might arise from the comparative cheapness and style of living. In former times three or four students used to divide among them one room, and two undergraduates slept together. He also stated, that had the comparison been taken as to the early years of both centuries, Cambridge would have been found declining, for that the number of graduations had been small during the war. On referring to Newman's translation of Huber, it was found that they had been 122 in 1810, and 149 in 1811, but that in 1822 they rose to about 300.

FRIDAY.

Mr. G. R. Porter read a paper, contributed by Mr. R. Valpy, 'On the Trade and Navigation of Norway,' being the abstract of a Report made to the Government by J. B. Crowe, Esq., Consul General for Norway. The chief exports are wood, fish, and minerals. The wood consists of deals cut in twelve feet lengths, and balks either round or square. Proprietors of forests are under no restrictions as to felling; they generally cut down the trees in autumn or winter, and convey them to a river to be floated down the stream. The reproduction of the timber is believed to be equal to the consumption. Formerly England was the chief market for Norwegian produce, and had in return the almost exclusive trade in manufactures; but since the establishment of discriminating duties in favour of Canadian timber, the English trade has fallen, and the consumption of English manufactures greatly decreased. Hamburgh and the German States have become markets for Norwegian produce, and the manufactures of Germany have superseded those of England. The annual average quantities of timber exported in the seven years from 1835 to 1841 were 618,769 loads of 50 cubic feet, which, with firewood, hoops, and other less valuable timber, may be deemed worth 435,000*l.* The fisheries rank next in importance to the forest, and afford the chief occupation to Norwegian industry. The exports consist of stock-fish, round and split, clip-fish, salted cod, and halibut, liver and shark oil, and live lobsters. Stockfish is chiefly exported to the Catholic countries of southern Europe. The exports fluctuate from the varying nature of the fishing trade, but in 1841 they were, stockfish, 14,196 tons, clip-fish 11,285 tons, herrings 608,086 barrels, cod-roes 20,217 barrels, liver and shark oils 41,715 barrels, and 552,272 lobsters. Salmon for several years has ceased to be an article of export. The disappearance of this fish is attributed to the swarms of sharks which have recently taken possession of the banks

off the coast. These were first observed in 1841, and in 1842 eight vessels were fitted out for the new fishery, and captured no less than 20,000 sharks, without any apparent diminution of the supply. The quantity of oil obtained was about 1,000 barrels. The mineral trade is not of much importance, but there is something curious in the fur trade, principally carried on with Russia. The greater part of the skins sold by the Norwegians are obtained from the Hamburgh merchants, who buy them in London from the Hudson's Bay Company; the Norwegians convey them to Finmark, from whence they are taken to Moscow and sold to the caravan traders for the purpose of being bartered with the Chinese for tea at Kiachta! The Norwegian shipping is on the increase, principally owing to the laws which require masters of vessels to give proof of their knowledge and skill by undergoing a strict examination.

Dr. Thurnam read an essay 'On the Liability to Insanity at different Ages;' the general conclusion was, that liability to insanity does not increase with years, but is greatest between the ages of twenty and forty.

Mr. G. R. Porter read a 'Sketch of the Progress and Present Extent of Savings Banks in the United Kingdom.'—After a few preliminary remarks on their political and moral value, he stated that these institutions owed their origin to Miss Priscilla Wakefield, who, in 1804, induced six gentlemen residing at Tottenham to receive deposits from labourers and servants, paying 5 per cent. as interest. Four years later eight persons, half of whom were ladies, took upon themselves the same responsibility at Bath. The first savings bank regularly organized was formed at Ruthwell, Dumfriesshire; its success led to many imitations, so that before any legislative provision had been made for their management, there were seventy savings banks in England, four in Wales, and four in Ireland. In 1817 an act was passed to encourage banks of savings in England and Ireland, but it was not extended to Scotland until 1835. Tabular statements of the progress of these banks illustrated their great success, but we

shall only take for comparison the returns of two years, 1830 and 1844 :—

	England.		Wales.		Ireland.		United Kingdom.	
Years.	Depositors.	Amount.	Depositors.	Amount.	Depositors.	Amount.	Depositors.	Amount.
1830	367,812	12,287,606	10,204	314,903	34,201	905,056	412,217	13,507,565
1844	832,290	25,112,865	18,690	599,796	91,243	2,749,017	1,012,047	29,504,861

The deposits are found to be greatest in the years when provisions are cheap and abundant. Instead of giving the absolute numbers, we shall quote the centesimal proportions of the different classes of contributors.

	England.	Wales.	Ireland.	Scotland.	United Kingdom.
Not exceeding £20	56·68	52·53	46·09	76·24	57·00
" 50	25·46	31·01	36·94	17·82	26·08
" 100	11·28	11·10	11·76	4·72	10·86
" 150	3·94	3·52	3·35	0·93	3·67
" 200	2·28	1·63	1·75	0·29	2·08
Exceeding £200	0·36	0·21	0·11	...	0·31

The average balances to the credit of each depositor in 1844 were, in England 30*l.*, Wales 32*l.*, Ireland 30*l.*, Scotland 14*l.*, and United Kingdom 29*l.* Tables were then given of the operations of the banks in the several counties. Next to Middlesex, Devonshire exhibited the greatest amount of deposit in proportion to the population, and this satisfactory result was attributed to the admirable management of the Exeter Savings Bank. Lancashire exhibited a very low amount of deposits, but this was explained by the fact that operatives find a more profitable investment for their money. Some fears were expressed of the effect of the reduction in the rate of interest; and the tables of classification of depositors formed by the Exeter and the

Manchester Savings Banks were produced and recommended for imitation.

The Bishop of Norwich directed attention to the evidence afforded by the Savings Banks of the improved condition of Ireland, not only materially, but morally, and attributed it to the diffusion of the National system of education, and the progress of temperance. Dr. Cooke Taylor and the Mayor of Cork confirmed what the Right Reverend Prelate had stated, and adduced evidence of the great improvement of the Irish people in their food, clothing, and habitations.—Signor Enrico Meyer gave an account of the moral effect produced by Savings Banks in Tuscany, and related some facts confirming the great national value of the temperance movement in Ireland.

Thursday.

Section G.—MECHANICAL SCIENCE.

This Section met, and adjourned.

THE

Calcutta Journal

OF

NATURAL HISTORY.

Notes on Indian Botany. By ROBERT WIGHT, M.D., F.L.S., *Member of the Imp. Acad. Nat. Curios. of the Royal Bot. Soc. of Ratisbon, &c. &c.*

AXANTHES. *Blume, D. C., &c.*

Flowers hermaphrodite, or male by abortion. Calyx urceolate. Corolla rotate, or parted nearly to the base, 5-9-lobed, very hairy within, valvate in æstivation. Stamens 5-9, scarcely exserted. Ovary inferior, or apparently half superior, being covered with a thick fleshy disk, 5-9-celled, with numerous ovules attached to dilated placentas: in the male, flowers flattened and plicate or furrowed on the margin. Style short or inconspicuous, being concealed by the disk, filiform, or wanting in the male flowers. Stigmas 5-9, at first connivent, somewhat clavate, afterwards spreading—wanting in the male flowers. Berry globose, crowned by the calyx, 5-9-celled, many seeded. Seeds minute, globose, scrobiculate, (pitted like a thimble) attached to fleshy placentas.

Trees or shrubs, with opposite lanceolate, acuminate leaves, glabrous above, usually pubescent on the veins beneath. Stipules usually about as long as the petioles, membranace-

ous, lanceolate deciduous. Inflorescence axillary, congested, corymbose, cymose or rarely umbellate. Calyx usually entire: limb dilated, cup-shaped, entire or lobed. Corolla usually rotate, but sometimes deeply parted, and then the lobes are triangular: when rotate, the short tube is nearly filled with the disk of the ovary. Berry, so far as I have seen, about the size of a pea, succulent.

I have described the flowers as occasionally male by abortion in place viewing the plants as diœcious, under the belief that the female organs only abort, as all the fertile flowers I have met with are bisexual, and the unisexual ones, all male. Such is the case in all my specimens.

This genus was established in 1826 by Blume, for the reception of four Java plants. In 1830, Decandolle added two others, one communicated by Blume, the other from the Island of Timour, since then no further additions seem to have been made. While arranging some collections received from Ceylon, Mergui, and Malacca, I found among them the following seven species, all of which appear new. These generally accord so well with the original generic character, as to leave no doubt of all belonging to the genus, though they do not all quite agree, on which account I have re-constructed it, with the view of giving somewhat greater extension.

1. Axanthes enneandra, (R. W.) arborescent? extreme ramuli 4-sided, glabrous: stipules subulate, shorter than the petioles: leaves coriaceous penninerved, linear-lanceolate, acuminated, glabrous on both sides: corymbs axillary, solitary, hairy, trichotomous, involucrate at the divisions; peduncle more than twice the length of the petiole: flowers numerous, small, longish pedicelled: calyx cup-shaped, crenate: corolla rotate; limb 8-9-cleft: stamens 8-9-sterile; ovary 8-9-plicate, surmounted with a short abortive style.

Hab.—Malacca. Griffith.

Obs.—The leaves are from six to seven inches long, by about one and three quarters broad, firm and coriaceous. The corymbs are the largest I have met with, being nearly two inches long, the bracts forming the involucrum, small triangular, densely strigose, each branch of the corymb ending in a cluster of pedicelled flowers. Of this I have not seen fertile specimens.

2. Axanthes longifolia, (R. W.) arborescent? ramuli obsoletely 4-angled, glabrous: stipules lanceolate hairy, longer than the petioles: leaves ovate, lanceolate, acuminate; about three times longer than broad, penninerved, glabrous on both sides: corymbs axillary small, dichotomous, hairy, involucrate at the division; bracts coarsely hairy: calyx cup-shaped: corolla rotate, 5-cleft: ovary sterile, flat, or somewhat concave above, 5-furrowed, surmounted by a filiform style.

Hab.—Mergui. Griffith.

Obs.—The inflorescence of this species much resembles that of the former, but is much smaller, being under an inch in length, scarcely longer than the petiole, the larger leaves are from nine to ten inches long, by about three broad, ending in a tapering acumen, and quite glabrous on both sides. My only specimen is a male, but the ovary is so nearly perfect, that mere change of season seems only wanting to make it produce fertile flowers.

3. Axanthes blumeana, (R. W.) aborescent? ramuli terete, strigosely pubescent: stipules caducous, linear lanceolate, hairy: leaves petioled, elliptic lanceolate, acute at the base, longish acuminated at the apex, penninerved, with straight transverse veinlets between, glabrous, except the petioles and veins beneath: corymbs axillary, solitary, contracted, a little longer than the petioles: calyx cup-shaped,

5-toothed entire: corolla very short, 5-parted to the base, divisions triangular: stamens 5; ovary sterile, truncated, 5-furrowed: no style.

HAB.—Malacca. Griffith.

OBS.—The leaves, including the petiole, are about four inches long, and one and a quarter broad, and end in a rather abrupt linear pointed acumen, about half an inch long. The character of the vernation in this species is important, as it at once distinguishes it from the following, which it greatly resembles in general appearance. The corymbs may be called compound, the pedicels forming a double series, the first coming off about the middle of the peduncle, the second forming a simple terminal umbel. Flowers small: corolla scarcely exceeding the calyx.

4. AXANTHES CEYLANICA, (R. W.) arborescent, glabrous; ramuli terete or obsoletely 4-sided, glabrous: stipules minute, triangular: leaves lanceolate, acuminated, glabrous on both sides, finely reticulated with slender brownish veinlets: inflorescence umbellate, umbels simple, axillary, usually paired: peduncles about the length of the petioles: calyx cup-shaped, entire or slightly toothed: corolla rotate, 5-cleft: ovary 5-celled, surmounted by an ovoid, fleshy, disk: style none: stigmas 5: berry globose, about the size of a rather large pea.

HAB.—Ceylon.

OBS.—I gathered specimens of this in 1836, and afterwards received others from Colonel Walker. I at first, on account of its bisexual flowers, supposed that this was Blume's A. CORYMBOSA: discrepancies between his character and my specimens induce me now to look upon it as a distinct species. It is quite distinct from all the preceding, but most

resembles the last in its general outline, though distinguished by many characters taken from the inflorescence and flowers, but especially by the vernation, which in this, resembles *Terminalia,* in that, *Lasianthus.*

5. Axanthes griffithiana, (R. W.) arborescent? ovary when glabrous: ramuli terete: leaves pale, glaucous, green, (when dry) elliptic-oblong, acuminate: stipules large, membraneous, ovate-lanceolate, slightly auricled, undulated: flowers umbelled, peduncles axillary, solitary, or rarely paired, about the length of the petioles; umbels simple, few flowered: calyx campanulate, entire; corolla small, glabrous, deeply 5-parted; lobes triangular acute; throat very hairy: anthers large: ovary inferior, 5-celled: berry globose.

Hab.—Malacca. Griffith.

Obs.—The larger leaves are about eight inches long by three broad, elliptical, but rather abruptly terminating in a longish almost subulate acumen. Its universally glabrous habit, is in this species an excellent character, all the others are somewhere hairy, especially the inflorescence, which in this is glabrous. The fruit, on my specimens are immature.

6. Axanthes elliptica, (R. W.) arborescent? ramuli terete, glabrous, or very sparingly pubescent: leaves elliptic, shortly and abruptly acuminated, glabrous above, paler and villous beneath, especially on the somewhat prominently reticulated veins, penninerved: stipules linear lanceolate, longer than the petioles, deciduous: corymbs short, sub-capital, solitary or paired: calyx cup-shaped: corolla rotate: anthers apiculate: style exceeding the disk: stigmas 5, connivent, ovary 5-celled.

Hab.—Ceylon, 1836.

Obs.—This species I found in Ceylon, and so far as I can make out from my collection, it has not been met with by any other. The rigid form, coriaceous leaves, and almost capitate inflorescence, distinguishes it from all the others. The leaves are about five inches long, by from one and a half to two broad. The bisexual habit, a point by which it approaches *A. corymbosa*, Bl., separates it from all his other species.

7. Axanthes hirsuta, (R. W.) arborescent? young branches terete, densely hairy all over: stipules lanceolate, acute, hairy: leaves elliptic lanceolate, acuminate, glabrous above, pubescent beneath, short petioled: flowers subsessile, aggregated in the axils of the leaves, bisexual: calyx and corolla coarsely hairy: stamens 5: anthers large: ovary 5-celled: style exceeding the disk: stigma clavate, 5-lobed.

Hab.—Malacca. Griffith.

Obs.—This species in some points nearly approaches, *A. strigosa*, Blume, but in others is remote from it, so far as can be made out by the brief and imperfect character he has given. It is not, however, without hesitation that I have defined this as a new species.

APADYTES. *E. Meyer, Bentham, Lin., Tr.*

Flowers bisexual. Calyx small, unchanged. Petals 4-5. Stamens as many, alternate with them, none sterile. Ovary 1-celled. Fruit ovate reniform, sub-compressed, bearing on one side a fleshy appendage. Inflorescence terminal. Bentham, Lin. Tr. vol. xviii. p. 680.

The above generic character was drawn up by M. Bentham for a plant from Port Natal in Southern Africa, and has been introduced here for the information of Indian Botanists, who may not have an opportunity of consulting the original, now that a species has been discovered in India. The genus, if

we are to take the contradictory opinions of the most eminent living Botanists regarding its affinities, belongs to *Olacineæ*, a small but curious order. On those opinions it is not my present intention to offer any remarks, my object being simply to make known a new species of one of the most recently established genera of the order.

Before, however, proceeding with the description of the new species, I may mention that the plant figured in my Icones, No. 955, under the name of *Stemonurus ? fœtidus*, appears more correctly referable to the genus *Icacina* than *Stemonurus*, and it seems not improbable, that both *Stemonurus* and *Gomphandra*, might be reduced, and their species referred to *Icacina*, the oldest genus of the three. There certainly appears no sufficient difference between *Stemonurus* and *Gomphandra*, and Mr. Bentham (l. c. p. 674), hints that the latter is not sufficiently distinct from *Icacina*. Mr. Bentham, for what reason is not stated, does not include *Stemonurus* in his enumeration of the genera of the order, though placed next *Gomphandra* in Endlicher's 'Genera Plantarum' and referred here, though doubtfully, by Blume, its founder.

Apadytes benthamiana, (R. W.) arboreous, ramuli terete, glabrous: leaves alternate, exstipulate, coriaceous, glabrous, oblong-elliptic, obtuse at both ends, from three and a half to four inches long, including the petiole, by one-half broad. Panicles terminal, erect, rigid, shorter than the leaves. Bractæ most minute or altogether obsolete. Flowers white, about three lines long. Calyx small, glabrous, 5-toothed. Petals oblong elliptic, inflexed at the point, glabrous. Stamens about the length of the petals: anthers linear obtuse, introrse, longer than the filaments, attached by the middle of the bark. Ovary free, hairy, ovate 1-celled with two lateral superposed, pendulous ovules: style slightly lateral, nearly straight: stigma truncated. Drupe semi-ovate, reniform, crowned with the persistent base of the style, and furnished with a lateral

scutelliform appendage, 1-seeded. Seed pendulous, obovate, cuneate, compressed. Embryo minute in the apex of a large albumen: radicle next the hilum.

HAB.—Neilgherries—very sparingly in woods near the top of the hill behind the Avalanche Bungalow; with flowers and fruit in February 1845.

Mr. Gardner and I found a single tree in the station cultivated, from which we obtained only a few indifferent specimens, owing, apparently, to the tree being in flower out of season, the best was one figured, and now in course of publication in my Icones. As a species, it is very distinct from the Cape one, and were the genus to be increased to such an extent as to render subdivision desirable, marks I dare say might even be found for its separation from the genus in the form of the ovary and style, and texture of the appendage. As the genus now stands, however, there can be no object gained by its removal on such artificial characters, and as adding one to the already numerous links connecting the Floras of India and Africa, it may be esteemed an interesting addition to our Flora. I met with this plant, or a distinct species of the genus, some years ago on the western slopes of the Shevagherry mountains, but in fruit only.

NICOLSONIA.

This genus like *Apadytes* is now for the first time admitted into the Indian Flora, its other species being natives of tropical America and the Cape. In habit, as well as in character, it approaches *Desmodium*, so much so, indeed, that I considered our species as probably referable to that genus, until Mr. Gardner suggested its true station in the order.

The essential distinction between the two genera lies in the calyx, which in *Desmodium*, is divided half its length

into two lips, 2-3-cleft, and is shorter than the corolla, while in *Nicolsonia,* it is divided to the very base into 5 hairy segments, and is longer than the corolla. Decandolle further assigns a several jointed legume, but this does not seem sufficiently constant, to admit of more than secondary value being attached to it as a generic distinction, as the number varies, and is even, in an instance given in Decandolle's figure, reduced to one. This portion of the generic character will for the future therefore, require to be modified, to admit our species, which seems uniformly to have a single jointed pod, and an ovary with usually, if not always, a solitary ovule. The same thing, however, happens in other genera, especially *Indigofera,* and is provided for by giving a little latitude to that part of the character, by which that very natural genus is kept together, which might easily be broken up into several artificial genera : the besetting sin by the way of some of those modern naturalists, who, looking upon our natural orders and our genera as mere human contrivances in the construction of which nature has no hand, seem to think it meritorious to make as many orders and genera as they can find artificial distinctions for, too often without, in the first instance, determining the value, as regards constancy of the characters they employ, in this unphilsophical proceeding. But quitting such discussions as irrelevant, and leaving each labourer in the field to follow the bent of his own inclinations, I shall at once proceed to describe my new *Nicolsonia,* first introducing the slight modification into the generic character, required for its admission into the genus.

"NICOLSONIA, D. C. calyx, 5-parted, segments subulate, bearded. Corolla shorter than the calyx. Legume straight, compressed, one or several jointed. Leaves pinnately trifoliate or simple, by the abortion of the lateral leaflets : flowers purple." The above is copied from G. Don's character (Gard. Dictionary) with merely the addition of the word *one*

in the character of the legume, which thereby admits this species without violence, or rendering the rest of the group less natural than before.

N. CONGESTA, (R. W. Icones No. 1056) suffruticose, diffuse, procumbent; all the young parts except the upper surface of the leaves pubescent, or hairy: leaves pinnately 3-foliate, or simple by abortion; leaflets from elliptic-obtuse to suborbicular, sometimes tending to obovate, slightly cordate, mucronate, sparingly pubescent beneath: racemes terminal capitulate: segments of the calyx subulate, setosely hairy: legume compressed, 1-seeded: seed reniform.

HAB.—On the banks of the Pycariah river, Neilgherries, frequent: sparingly about Ootacamund. Flowering during the cool season, but probably to be met with in flower at all seasons.

OBS.—This is a procumbent, very diffuse plant, two or three feet long, much resembling in habit and general appearance, *Desmodium triflorum,* except in the inflorescence, which is capitulately congested on the extremities of the branches: branches terete, the older ones woody, glabrous: stipules and bracts scariose, ciliated with soft white pubescence. The leaves vary much in size, generally they are simple, being reduced to the terminal leaflet, but the lateral pair is sufficiently frequent to show, that such is the normal form. The terminal leaflet, when all are present, larger, often broader above, subcuniate, generally oblong elliptic, slightly cordate at the base. Inflorescence, racemose, congested, forming terminal capitula. *Segments* of the calyx narrow, subulate, clothed with coarse setaceous brown hairs; longer than the small purple corolla. Legume reniform glabrous, 1-seeded. Seed lenticular, reniform.

On some new species of COMPOSITÆ.

Much importance is deservedly attached to modifications of the pappus, in the construction of generic characters of *Compositæ,* as that organ presents a considerable range of variations of form and texture. Here, however, as in all other cases, the general rule has its exceptions, and examples occasionally occur, affording but too good reason to fear that on some, if not many occasions, more stress has been laid on modifications of this organ in the construction and limitation of genera, than it is qualified to bear: under this impression, I have prepared descriptions and analysis of three unpublished plants of the order, all so much alike in general form, that, until somewhat closely looked into, they might almost be supposed, varieties of the same species, two assuredly might, and in fact were supposed the same species by both Mr. Law (their discoverer) and me, until I examined the fructification when the differences at once became obvious, and showed that each of the three might almost be referred to separate genera.

The one I have called *Doronicum tomentosum* will, I believe, be admitted on all hands to be a genuine species of that genus: *Doronicum reticulatum* will equally I think be admitted into the genus, but as the type of a section, on account of its subpaleaceous not setose pappus, while the last, as being altogether destitute of pappus, must of necessity, under existing arrangements, be referred to a different genus; and as I am unable to refer it to any of the present list, have constituted it the type of a new one, bearing the same relation to *Doronicum* and the radiate sections of *Senecio,* that *Osmitopsis* does to *Osmites,*—that is, the latter in both cases has pappus, the former none.

Such being the practice established by those whose extensive study of the peculiarities of the order, give them authority to prescribe rules for the guidance of others less fortunate-

ly situated, it of course behoves me in the present instance to follow in their footsteps and add a genus to the order, merely differing from *Doronicum* in the disk; the achænia being bald, while in it, they are crowned with pappus.

This reasoning from analogy, seems rather an arbitrary proceeding, as it is admitted by all botanists, that the pappus is simply the limb of the calyx modified by peculiar circumstances, causing it to assume various shapes in different species; while its absence is attributed to its growth being arrested by the pressure of the surrounding parts.

In the case of *Doronicum* and some others, this mode of accounting for its absence seems scarcely satisfactory, as it is difficult to imagine how a greater pressure should be exerted on the outer ray florets, in which only it is deficient, than on the disk ones. Neither can I imagine how, in plants so much alike in all their external features as those now under consideration, that organ should present such variations, the assigned cause being the same in all. These examples lead to the inference, that the endless variations observed in this organ, viewed in connexion with their constancy in each species, are referable to the operation of some other and higher cause than mere pressure of the surrounding parts, which can scarcely be supposed to act so uniformly as the constancy of the effect indicates. I do not wish it to be inferred from these remarks, that I would go so far as to deny that pressure, in the manner supposed, exerts powerfully modifying effects on parts exposed to its action: I merely wish to hint that there is ground for questioning the correctness of the theory to the extent claimed for it by its supporters.

Taking this view of the matter, I willingly accord a high value to characters derived from the pappus, higher perhaps than I should feel inclined to yield, could I persuade myself to look upon it simply as the limb of the calyx, modified in its development by the pressure of surrounding parts. *Senecio* and

Doronicum, with many others, furnish cases in point as to the unsatisfactoriness of the theory, which is still further weakened when subjected to the test of analogy, cases are not wanting in other families, uninfluenced by any such cause, where some species of even the same genus, have the limb of the calyx fully developed, while in others it is reduced to little more than a mere margin, and why might not the same happen in Compositæ from other causes than pressure. How should pressure produce setaceous pappus in one and paleaceous in another. Admit that analogy is equally applicable in both, and what becomes of *Osmitopsis:* "Omnia *Osmites* sed ligulæ constanter neutræ et achenia omnino calva," or *Doronicum,* which only differs from the radiate *Senecios* in having the "Achænia radii calva" while in the other they are crowned with pappus. Mere pressure which in the nature of things must be as great in the centre as the circumference, is surely unequal of itself, to produce so constant and uniform an effect as this last example implies. Influenced by these views, I fully acknowledge on account of their constancy, the value of characters taken from the pappus, though I hesitate to adopt the theory proposed to account for the numerous variations of form, which the limb of the calyx in this family is ascertained to assume, because it does not appear satisfactory, or sufficiently comprehensive, to meet the numerous anomalies which the subject presents.

DORONICUM.

D. TOMENTOSUM, (R. W.,) Stem herbaceous and sub-tomentose, at first simple, leafy; afterwards corymbosely branched and nearly naked: lower leaves elliptic, tapering to the base; upper ones somewhat ovate, lanceolate, auricled sub-amplexicaul; Coarsely and unequally dentate; above rough and slightly arachnoidose; beneath densely tomentose, white: corymbs lax, peduncles bracteolate: ligulæ about 14-sterile;

disks numerous, 5-cleft; pappus setaceous hispid: achænia costate hairy.

Hab.—North-western slopes of the Neilgherries below Neelawuttem. Flowering September and October.

Obs.—The plant seems annual, attains the height of from ten to twenty inches, terminating in a few-flowered-corymb of yellow flowers, or rather capitulæ; the stem which is simple towards the base, is sparingly tomentose, ribbed, divides above into three or four branches, each bearing a few capitulæ. The leaves are elliptical in their outline without any proper petiole, as the limb is decurrent to its insection, and there expands into an auricle which, in the upper leaves, is somewhat amplexicaul: above, rough to the touch and clothed with a thin cobweb-like pubescence; below with a thick coat of white tomentum. Bracts few, subulate: scales of the involucrum linear acuminate, pubescent: ligulæ linear, 4-nerved, 3-toothed at the apex: stigma wanting or 2-lobed, but apparently sterile: flowers of the disk bisexual, 5-cleft tubular: pappus nearly as long as the corolla, setaceous, rough: achænium linear, costate, hairy on the ribs.

D. reticulatum, (R. W.) herbaceous, erect, ramous; stem and branches glabrous: leaves somewhat rhomboidal, coarsely and unequally dentate, teeth mucronate; above rough and arachnoidosely pubescent: beneath tomentose between the veins: veins glabrous (hence reticulated). Corymb lax, capitula longish pedicelled; bracts subulate: ligulæ 10-12-sterile, naked, the throat crowned with a tuft of hair: disk flowers numerous, 5-cleft, tube contracted, throat campanulate: pappus equalling; the tube paleaceous, subulate, hispid: achænium ribbed, conical, hairy.

Hab.—Thannah District Bombay, Law. Except that this is a larger and more ramous plant than the preceding, they are

much alike in habit, and much of the same description applies to both. The difference in the form of the disk. Corolla and pappus is however quite sufficient to keep them far apart, even though in their external characters they were much more nearly related, than they actually are.

Obs.—These two species are properly referable to Decandolle's genus, *Madaractis*, the essential character of which is to have the ray flowers *neuter*, not *female*, as in *Doronicum*, but curiously enough, the author has himself proved it an unnecessary addition to the list, by having previously described under Doronicum, every species subsequently referred to *Madractis*, thus *M. pinnatifida* is *Dor. candolianum: M. scabra* is *D. lessengianum : M. polycephala* is *D. arnottii :* and *M. glabra* is *D. wightii*. The distinguishing character being one of such secondary value, I propose uniting these genera by allowing the ray florets to be either neuter or female, thus : *Doronicum* capitulæ radiate heterogamous ; ligulæ female or sterile, by abortion, without pappus.

MADACARPUS. (R. W.)

Capitula radiate heterogamous. Ray flowers one series, ligulate sterile : disk one, flowers numerous hermaphrodite. Achænium beakless, oblong, costate hairy, without pappus. Herbaceous plants, capitula corymbose ; involucrum campanulate, one series ; scales linear lanceolate mucronate : receptacle convex, foviolate. Corolla sub-infundibuliform, costa of the achænium hispid.

M. Belgaumensis, (R. W.) Belgaum, Law. I am indebted to Mr. Law of Bombay for my specimens of this plant, which, from agreeing so perfectly in habit with *Doronicum reticulatum*, both he and I at first considered, at most, but a variety of that plant.

Annual, erect, ramous, pubescent : lower leaves longish petioled, from broad ovate obtuse to suborbicular, slightly

cordate, unequally crenato-dentate, auricled at the base ; middle ones ovate lanceolate, short petioled ; upper floral ones linear lanceolate, all nearly glabrous above, and tomentose beneath. Capitula corymbose, long pedicelled, heterogamous. Involucrum one series, squamæ cohering at the base, linear lanceolate, mucronate. Receptacle conical foviolate. Ligula linear, 4-nerved, about 8-sterile. Style and stigma none. Flowers of the disk tubular, enlarging at the throat, subinfundibuliform, 5-cleft, the segments with a distinct mid-rib. Anthers ecaudate. Stigmas recurved, truncated. Achænium 10-nerved ; nerves setosely hispid : pappus none.

CYATHOCLINE.

Cyathocline lutea, (Law, MSS., R. W. Icones 1150.) Annual erect : leaves nearly all radical bipinnatifid ; thickly beset with minute transparent glands (?) stems erect scape-like, somewhat ramous : branches axillary slender bearing several capitula on the apex : flowers yellow.

Hab.—Thannah District near Bombay. Law.

Obs.—Mr. Law recently sent me specimens of this very pretty little plant, which is at once distinguished from the rest of the genus by its bright golden yellow flowers ; while its scapiform habit, and mossy looking leaves, shew, that it is a very distinct species. Its whole height varies from three to about six or seven inches : the largest leaves do not exceed an inch in length, and are so delicate, that, after drying, they require the aid of considerable magnifying power to show their structure.

In addition to this I received from Mr. Law, specimens of other two species, under the names of *C. lyrata* and *C. stricta.* It was long before I detected the difference between these two species, as given by D. C., probably from having a specimen of each under one name, which led me to confuse the characters,

and with them, the new specimens sent. The distinguishing character between the two, is sufficiently evident when carefully looked for, but may easily be overlooked, even when both are before our eyes. In *C. lyrata,* the lobes of the leaves increase in size as they approach the apex; in *C. stricta,* both the leaves generally and the separate lobes, have a somewhat pyramidal outline, broader at the base and tapering towards the apex.

Having discovered the distinctions and been thereby enabled to name correctly my original specimens, which had been previously confounded under one name, I have also ascertained that the Bombay plant is *C. stricta,* D. C., that my *C. lyrata* (Icones 1098,) from the Neilgherries, is truly that species, and that Mr. Law's *C. stricta* is a new species, which may be thus distinguished from the others.

Cythocline lawii, (R. W.) Annual erect, simple, slender, slightly pubescent: leaves delicately membranaceous bipinnate, pinnæ alternate, upper one larger, serrately pinnatifid: capitula short, pedicelled, congested on the apex of the stem.

Hab.—Bombay. Belgaum. Law.

Obs.—"Cyathocline stricta? a pretty delicate plant with bright green leaves," Law's MSS. The leaves, which seem as delicate as those of a Jungermania, and which, by the way, the pinnæ much resemble in form, are large for the size of the plant, some of them being nearly two inches long on specimens nine inches high: the capitula are rather numerous, on slender short pedicels congested on the apex, smallish, apparently pink coloured.

Sphæranthus amaranthoides, D. C. Judging from the circumstance of Decandolle, having distributed the species of Sphæranthus under three sections, it would appear that they present considerable diversity of character, which may possibly lead to some of them, when carefully examined, being

removed to form types of distinct genera. The one under consideration seems to merit this distinction, a point on which, however, I speak with less certainty as my acquaintance with the genus is limited to two or three species, all differing widely from this, both in habit and structure, which encourages me to constitute it the type of a new genus.

Decandolle associates with this plant, in his section *Polycephalos, Sp. Swaveolens,* S. Indicus, Lamark, a species figured by Lamark and Gærtner, and of which I have specimens, but which, so far as I can judge from this data, seems much more nearly allied to *S. hirta,* a common Indian plant, placed in a different section. This on the other hand is most distinct, differing widely from both in habit, and in floral structure. In habit it differs in the form, decurrence, and clothing of the leaves, and in the glomeruls being quite sessile; while in the others it is peduncled. In these the capitula are surrounded by several series of bractial scales all about the same size, and have two or more male flowers, with numerous female ones springing directly from the rachis: in this I find invariably, one of the bracts much larger than the rest, dilated at the base (forming a general involucrum) and terminating in an elongated subulate point or mucro, corresponding with a sessile, solitary, large, hermaphrodite central flower, and three or four smaller, broad truncated, folded ones, corresponding with as many slender, pedicelled, female flowers, the pedicels adhering nearly their whole length to the base of the bracts. The corolla of the hermaphrodite flower is cylindrical, 5-toothed, thick and friable, apparently composed of a congeries of square cells (similar in form to those composing the sheath of a plantain leaf) with the filaments attached to the base; anthers oblong, the ovule perfect, maturing into a 4-sided glabrous seed, about twice the size of those of the female flowers; seed of the female flowers oblong, terete, hairy.

Differences such as these, mark this as a very distinct species, if not a good genus, and which, not being noticed by

D. C., leads to the inference, that he had not examined minutely its flowers, but took his character entirely from the exterior organs, and further, that had he observed them, he would most probably have constituted this the type of a new genus. Under this impression I now do that which I think he should, and would have done, had leisure permitted him more critically to examine the plant. And as Cassini's genus Oligolepis is unquestionably a genuine Sphæranthus and his most appropriate name vacant, I transfer it to this new genus, with the following generic character.

OLIGOLEPIS (R. W. not Cassini.)

Capitula heterogamous about 5-flowered, densely aggregated into an oblong conical glomerul. Flowers all tubular: female slender, pedicelled, subcylindrical, 3-dentate, 1-series (usually 4) in the circumference: hermaphrodite in the centre, sessile, solitary, 5-toothed, much larger. Style in the central flowers undivided. Achænium beakless, of the females terete, hairy, of the hermaphrodite obsoletely 4-sided, glabrous: pappus none.

Glabrous herbs, with decurrent subspathulate leaves and dense, sessile, axillary, glomerul: involucrum 1-series, usually 1-scale to each flower, or fewer by abortion? that of the hermaphrodite much larger acuminated; those of the females smaller, broad, truncated at the apex, adhering at the base to the pedicel of the flower, all glabrous. Corolla of the hermaphrodite flowers composed of large quadrangular cells easily conspicuous under a low magnifier.

O. AMANTHOIDES, (R. W.) Icones No. 1149, inadit. *Sphæranthus amaranthoides,* Burm Fl. Ind. D. C. Prod. 5—370 usually met with in paddy fields near the sea-coast.

GISEKIA.

This genus was established by Linnæus on an obscure Ured-like procumbent plant of frequent occurrence in pastures and neglected grounds in Southern India, to commemo-

rate Gisekie a pupil who contributed largely to make known his master's ideas regarding the Natural System of Botany, by the publication of notes taken down from his lectures. The plant seems hardly worthy of the name it bears, but still, it serves as well as the most magnificent tree of our tropical forests, to keep in remembrance the name of the Botanist who conferred that service on the science, but who, so far as I am aware, contributed nothing further to its advancement.

From that time until the present, no second species has been discovered, I therefore feel much pleasure in being made the medium of bringing another to light. Of this, apparently rare plant, I am indebted to Mr. E. J. Stokes, of the Bombay Medical Service, for a single specimen, a figure of which accompanied by one of the original species, is now in course of publication in my Icones. The two species may be thus briefly distinguished.

G. PHARNACIOIDES, (Lin.) procumbent, very diffuse: leaves succulent, obovate-lanceolate, obtuse: flowers axillary, aggregated, short, pedicelled.

G. MOLLUGINOIDES, (R. W.) erect or ascending: leaves linear lanceolate: corymbose, axillary, peduncles about the length of the leaves, flowers longish pedicelled.

HAB.—Deesa. Stokes.

OBS.—In habit this plant resembles *Mollugo stricta*, whence the name, but seems more erect. Annual, ascending, ramous: leaves narrow, lanceolate, bluntish, glabrous above, clothed with short closely appressed hairs beneath. Inflorescence corymbosely panicled, peduncles axillary, about the length of the leaves, slender; pedicels filiform. Calyx 5-sepaled; sepals obtuse imbricating membranous on the margin. Corolla none. Stamens 5, alternate with the sepals: filaments dilated at the base, subulate: anthers adnate. Ovary of 5, 1-celled,

sessile carpels, with a single erect ovule in each, styles adherent to the inner angles of the carpels: stigma subulate pubescent, reflexed. Utricles setosely hispid. Seed subreniform, clear, shining black. Embryo annular, embracing a copious farinaceous central albumen.

EXPLANATION OF PLATES III AND IV.

I.—Axanthes longifolia.

1. Cluster of flowers.
2. Corolla laid open, showing the hairy throat and stamens in situ.
3. Stamens, back and front views.
4. Sterile ovary cut vertically—all magnified.

II.—Axanthes ceylanica.

1. Portion of a cluster of flowers.
2. Corolla laid open.
3. Stamens.
4. Calyx and ovary as seen after removing the corolla.
5. Ovary cut vertically.
6. —— cut transversely.
7. A seed-cell more or less magnified.

III.—Axanthes elliptica.

1. Cluster of flowers.
2. Corolla laid open.
3. Stamens, back and front views.
4. Ovary cut vertically.
5. —— cut transversely, all magnified.

IV.—Apadytes benthamiana.

1. A flower opened artificially.
2. A petal detached.
3. Stamens.
4. Ovary and calyx.
5. —— cut transversely, showing the ovules.
6. Cut transversely.
7. Fruit nearly mature.
8. —— cut vertically, showing the position of the seed.
9. Seed cut longitudinally, showing small embryo in the apex of the larger albumen.
10. Embryo detached, all magnified.

V.—Apadytes benthamiana.—*(Continued.)*

1. Flowers and bract.
2. Vexillum detached.
3. The other petals.
4. Ovary and stamens.
5. The nine cohering stamens.
6. Detached anthers.
7. Ovary cut longitudinally.
8. Legume and calyx.
9. ——— laid open, seed in situ.
10. Detached seed.
11. Seed, testa removed.
12. Upper and under surfaces of the leaves, all magnified.

VI.—Dor. tomentosum.

1. Ray flower without pappus.
2. Disk flowers.
3. —— laid open, showing the stamens, style and stigmas.
4. An achænium with its pappus.
5. —— cut vertically.
6. —— transversely.
7. Cotyledons detached.
8. A situ of pappus, all magnified.

VII.—Dor. reticulatum.

1. Entire capitulum, slightly magnified.
2. A ray flower.
3. Disk flower with ovary and pappus.
4. Corolla detached.
5. Achænium and pappus.
6. ———— cut vertically.
7. Detached palea of pappus, all magnified.

VIII.—Madacarpus belgaumensis.

1. Entire capitulum.
2. A ray flower.
3. A disk flower.
4. ——— laid open.
5. Detached anthers.
6. Achænium.
7. ———— cut vertically.

IX.—Cyathocline lutea.

1. Entire plant, natural size.
2. Capitulum.
3. ——— cut vertically, showing the form of the receptacle and flowers in situ.
4. Male flowers.
5. Cut open, showing the stamens and sterile style.
6. Detached anthers.
7. Female flower and ovary.
8. Achænium.
9. A detached leaf, all magnified.

Observations on the Structure and Affinities of the Plants belonging to the natural order Podostemaceæ, *together with a Monograph of the Indian species. By* George Gardner, F.L.S. *Superintendent of the Royal Botanic Gardens, Ceylon.*

The natural order *Podostemaceæ*, one of the most remarkable, as well as the most Protean, in the vegetable kingdom, has representatives in nearly all parts of the world within the tropics, although it is, comparatively speaking, but recently that Botanists have become acquainted with them. About seventy years ago, the first species was made known by Aublet in his valuable work on the plants of French Guiana, under the name of *Mourera fluviatilis*, and about twenty years afterwards, viz. in 1803, a North American species was published by Richard in the 'Flora Boreali Americana' of Michaux, under the name of *Podostemon ceratophyllum.* Since that period, many new species have been described, principally from Brazil, Guiana, and Madagascar, and some new genera established. Until the publication of Dr. Wallich's Catalogue, which bears the date of 1828, no species was known to exist in the East Indies. In it we find a solitary species of *Podostemon (P. Wallichii* R. Br.*)* enumerated under number 5225, which was found by Gomez in the mountains of Sylhet. In the year 1835, the

same species and another, were found by the late Mr. Griffith in Assam, and their description forms part of a valuable paper which he published in the 19th Vol. of the 'Asiatic Researches.'* Since that period no new species have been published, belonging to the Indian Flora.

In the early part of last year (1845), having been sent by the Government of Ceylon to visit Dr. Wight at Coimbatore, on matters connected with the Botany of the Island, we spent the month of February together on the Neilgherry mountains, where we made very large collections. Among many other plants, we found no less than three species of *Podostemon*, on rocks in rapids in the bed of the Pycarrah river. These, together with another which I possess from Dr. Wight, found by him the year before in the same stream, and three species which I have lately discovered in Ceylon, as well as a species of *Tristicha*, which I have also lately added to the Flora of the Island, I purpose to give detailed descriptions of in this article. Before doing so, however, I shall make a few observations on the habit and structure of the plants which comprise the natural order, on the characters of the genera, and on the relations which the order bears to other tribes.

The whole of the plants belonging to the order are truly aquatic in their habits; and it is but seldom that they are found in still water, the most of them growing on rocks and stones in rapids and water-falls. Most of them are annuals, at least all those which I have met with, either in the New or the Old World are so, and are only found in flower in the dry season, when the water in the streams is very much diminished. They only come into flower just as the water is

* It is not very creditable to our literary taste in Ceylon, that there does not exist either in the Public Libraries of Colombo or Kandy, a complete set of the 'Asiatic Researches,' although it is a work which bears so intimately on the History, Religion, Antiquities, Languages, and Natural History of the Island. For the use of the part containing Griffith's paper, I am indebted to the kindness of Dr. Wight, having been obliged to send to India for it.

about to leave them, the spathe remaining closed till it comes into contact with the air. In this manner we find on the same slanting piece of rock, and within a few inches of each other, patches of these plants which have gone through the whole process of vegetation and fructification, dried and shrivelled up, so that scarcely a vestige of them remains, along side of others which are perfecting their seeds. To these succeed those which are just bursting into flower, while in the deeper water, others are ready to follow them, as soon as the waters have fallen a little further. The seeds, which have a mucilaginous coat when moistened, are shed on the rocks during the dry season among the remains of the plants which produced them, and lie there till they are moistened by the first rains, when they adhere firmly to the spot on which they have fallen, and are thus prevented from being carried away by the floods of the rainy season. Vegetation is entirely carried on while they are submerged, and by the next dry season the plants are ready to go through all the changes of their progenitors.

The nature of the stems, branches, and leaves of these plants is very remarkable, alike in the variety of forms which they assume, as in their organic structure. They consist almost entirely of a homogeneous mass of cellular tissue, and, in this respect, resemble the algæ and other low types of the vegetable kingdom. Griffith, in speaking of the two species which he has described says, "in neither of these plants have I been able to ascertain the existence of any vascular tissue, the place of which appears to be supplied by fibres of very small diameter packed very closely together, and, at least after maceration in spirit, filled with grumous matter." Like other submerged plants they are destitute of stomates.

In systematic Botanical works, much diversity exists with regard to the limitation of the genera of this natural order. The genus *Mourera*, as modelled by Professor Endlicher,

is made to contain a very heterogeneous mass of species, his three sections forming, in my opinion, three very distinct genera, that is, three types of structure, differing both in habit, and in the nature of their flowers. The last section, *Mourera*, should alone belong to the genus, being well distinguished by its spicate polyandrous flowers. *Marathrum* of Humboldt and Bonpland, forming the second section, is also well characterized by its habit and definite stamens. *Neolacis* of Chamisso, the first section, is more nearly related to *Podostemon*, than to either of the other two sections.*

By Endlicher *Mourera* is said to possess a perigonium consisting of "Squamulæ 2, collaterales, vel plures indefinitæ, verticillatæ;" and they are said to alternate with the stamens. I regret that I do not possess a flower of any published species of the genus, but judging from those of an unpublished *Marathrum*, which exists in my Brazilian Herbarium, and from what exists in *Podostemon*, these scales I believe to belong to the same whorl as the stamens. It is only in the genus *Tristicha* that a true perigonium exists. *Mourera* was long known by the name of *Lacis*, Schreber, in his edition of the Linnæan 'Genera Plantarum', having taken the unwarrantable liberty of changing many of the names of the genera which had been established by Aublet: this too without any reasonable motive, and without being acquainted with Aublet's plants further than from his figures and descriptions. His name has thus been branded with a stain, which, it is to be hoped will pre-

* The great object of the classification of plants being to bring together those which most nearly resemble each other, so that the student of Botany may, by the contrast of their characters, be able not merely to distinguish one plant from another, but to gain a knowledge of their structure from their written characters, I firmly believe, that more doubtings, difficulties, and impediments have arisen from the incautious grouping of plants together under a common character, taken only from a few points of resemblance, than ever has resulted from an opposite course. Every working Botanist, who like myself, is placed in circumstances which necessarily confines him to a limited library, must have felt the truth of this observation.

vent any one in future from following his example. In the 6th Vol. of the 'Memoirs of the Academy of St. Petersburgh,' Bongard has published several Brazilian species of this tribe, under the name of *Lacis;* but, according to Lindley, they all belong to *Mourera*, with the exception of one species *(L. Monadelpha)*, and for it Lindley has proposed to continue the name *Lacis*, being well distinguished from *Mourera* by its monadelphous stamens.*

* I shall here give a description of the new Brazilian species of *Marathrum* above alluded to.

MARATHRUM *lacunosum, Gardn.*

M. frondibus depressis suborbicularibus irregulariter lobatis sinuatisque, floribus e fossæ horizantali ad partim superiorem frondium exsertis solitariis, spathâ tubulosâ irregulariter, 4-5-lobatâ, staminibus 8, filamentis alternis antheriferis alternis sterilibus. MARATHRUM *lacunosum, Gardn. Herb. Fl. Braz. n.* 5860.

HAB.—On Granite rocks in the bed of the Rio Paquequer Grande, near Canta Gallo, Province of Rio de Janeiro, Brazil. April 1841.

DESCR.—*Frond* depressed, suborbicular, scarcely an inch in diameter, irregularly lobed and laciniated, its under surface firmly attached to the rock on which it grows. *Flowers* solitary, arising from deep wide horizontal concavities which exist on the upper surface of the frond. *Spathe* tubular, clavate, irregularly 4 or 5-lobed at the apex, slightly scabrous externally, three or four lines long. *Pedicel* cylindrical, about five lines long. *Floral envelopes* none. *Stamens* 8, hypogynous, unilateral and external with regard to the axis of the frond: *filaments* alternately barren and fertile: *sterile* linear, subulate, and shorter than the capsule: *fertile* linear, complanate, about as long as the capsule, each bearing a single anther: *anthers* linear-oblong, cordate at the base, spirally twisted when dry, 2-celled, cells bursting longitudinally. *Pollen* yellow, globular. *Ovary* sessile, superior, obsoletely 8-sulcate, 2-celled. *Ovules* numerous, ascending, attached to fleshy dissepimental placentæ. *Style* none. *Stigmata* 2, sessile, reniform, with laciniated margins. *Capsule* oblong, about one and a half lines long, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* attached to the dissepiment, all of which ultimately become free. *Seeds* numerous, ascending, elliptical, obtuse, compressed: *testa* brownish. *Embryo* exalbuminous, dicotyledonous, orthotropous: *cotyledons* thick: *radical* obtuse, short, pointing towards the hilum.

OBSER.—It is not without some hesitation that I refer this plant to *Marathrum*, and have done so chiefly because I am not well acquainted with the species of which the genus is composed. The arrangement of the stamens differs from that of those of the original species *(Marathrum fœniculaceum*, Humb. et Bonp.), in being unilateral, and not, as in it, regularly surrounding the ovary. I regret much that

Podostemon is a very distinct genus, being distinguished from all the others by having four unilateral filaments. The two external ones are barren, and are what Endlicher and others consider segments of a perigonium, but which in eight Indian and one North American species of the genus which I have examined, I find, as previously remarked, to belong to the staminal whorl. The two intermediate filaments are united nearly to the apex, and each fork bears a 2-celled anther. In the first supplement to his 'Genera Plantarum,' Endlicher has constituted a new genus under the name of *Hydrobryum* for the two East Indian species of Podostemon published by Griffith in the 'Asiatic Researches,' but on very insufficient grounds. The only point in which he makes the character of the new genus to differ from that of *Podostemon*, is in the nature of the spathe, that of *Hydrobryum* being said to burst irregularly, while in the other it is said to be diphyllous. Even did this difference exist, which it does not, it is far from being of sufficient importance to constitute a generic distinction. In my Herbarium I possess a fine set of specimens of the original species of *Podostemon (P. ceratophyllum)*, collected in North America by Beyrich, and the examination of several flowers, enables me to state, that the nature of the organ in question, is quite what I find it to be in the Indian species. The spathe is glabrous, and bursts irregularly at the apex into three or four obtuse lobes. I find besides, that in the structure of the stamens, the capsule, and the seeds, this plant agrees in every respect with the Indian ones, proving the accuracy of the original views of Brown and Griffith. In *Podostemon* the pollen presents a remarkable peculiarity, being of an

I have no opportunity of consulting Bongard's paper on this tribe, but judging from the specific character of his *Lacis membranacea*, which Endlicher refers to *Marathrum*, that species seems to agree very well with mine in habit. The most remarkable points connected with the present plant are the curious pits which enter the frond horizontally on its upper surface, and out of which the solitary flowers proceed, and the reniform laciniated stigmata.

oblong shape, with an hour-glass construction in the middle. This was first noticed by Griffith in his two species, and I find that it also exists in my seven new ones, and in the one from North America; but it does not exist in the species of *Marathrum*, nor in the two of *Tristicha*, which I describe in this paper.

Mniopsis of Martius is nearly allied to *Podostemon*, being principally distinguished by its peculiar habit, a tooth that exists in the fork of the united filaments, which is probably the rudiment of a fifth filament, and by its smooth, not ribbed, capsule.

Tristicha of Thouars, a musciform cosmolite genus, is perhaps the most interesting of the whole group, as the more perfect structure of its flowers leads to important conclusions, with regard to the natural affinities of the tribe. It is well characterized by its true perigonium of 3 imbricated segments, 1-3-stamens, all of which are fertile, and 3-celled ovary.

The two remaining genera *Hydrostachys* and *Halophila*, of Thouars, are natives of Madagascar, the Red Sea, and the Ladrone Islands, with opposite, stipulate? leaves, and plantago-like spikes of flowers, the structure of which are not so well known as those of the other genera.

But little, that is satisfactory, has yet been pointed out with regard to the affinities of these plants, notwithstanding that some of the most eminent Botanists of the age have written on the subject. Kunth, Richard, Martius, Bartling, Arnott, and Bongard, consider the mass of their relationships to be with monocotyledons. It is curious that although Bongard held this opinion, he was the first to show that the embryo is truly dicotyledonous. This fact has been confirmed by Griffith, and I have myself determined such to be the case in two species from Brazil, and in four others, which are natives of India. The seeds are exalbuminous, and the radical is inferior and directed towards the hilum.

Martius, guided by the simple nature of their vegetative organs, by the character of their spathe, and the sudden emersion of the pedicel at the time of flowering, considers them to form a transition from *Niades* to *Juncaginaceæ*, touching upon *Araceæ*, and as being a kind of noble analogy of *Hepaticæ* among monocotyledons. Griffith considers *Podostemon* to be more closely allied to *Pistiaceæ* than to any other known order.

Lindley was the first to consider the order a truly dicotyledonous one, and to give it a much higher rank in the natural system than it had previously occupied, placing it in the *Achlamydeous* group of his sub-class *Incompletæ*, along with *Piperaceæ* and *Monimiaceæ*. This was not done, however, without observing that, from the fact of there being a decided perianth in the genus *Philocrene*, Bong. (*Tristicha*, Thouars), they were still perhaps too low in the scale, and ought rather to be placed in the *Rectembryose* group, near *Lacistemaceæ*. In the skeleton of a new arrangement which he has given in his 'Elements of Botany,' the order holds much the same position as it does in the second edition of his 'Introduction to the natural system,' being placed in the dissolved series of the class *Homogens*.

Endlicher has no original views regarding the affinities of the order, and I am not aware that any other exist among the writings of Botanists, than those I have mentioned. The view which Lindley has taken, is certainly more satisfactory than any other which has yet been offered; but a somewhat attentive examination and consideration of these plants, has convinced me, that they have other and nearer relations than those he has alluded to. In balancing the affinities of plants, great weight should be given to the organs of vegetation; but in the present case, as in a few others, the organs of reproduction, must be entirely depended on in our calculations. Taking these as our guide, I shall briefly glance at what I conceive to be the natural position of the order.

No one has hitherto alluded to the resemblance which exists between *Podostemaceæ* and *Nepenthes*, a resemblance so great, that I am surprised it has been overlooked. If we compare them carefully, we shall find that in both there is a decided perigonium, for we must take *Tristicha* as the type of *Podostemaceæ*, with an imbricated æstivation. It is true, that the stamens in *Nepenthes* are united into a solid column, but we must remember, that the flowers are unisexual, and that in the nearly allied order *Aristolochiaceæ*, they are usually free; nor must it be overlooked, that in *Lacis* among *Podostemaceæ*, the stamens are monodelphous. This moreover, could scarcely be considered even as a point of ordinal distinction, for we find among *Euphorbiaceæ*, every variety of union and separation among these organs. In both *Podostemaceæ* and *Nepenthes*, we find a superior several celled ovary, with numerous ascending ovules attached to the dissepiments, no style, and stigmata equal to the number of cells in the ovary. The fruit in both is capsular, but the one has a loculicidal, and the other a septicidal, dehiscence. In both, the seeds are numerous, ascending, and imbricated. In both, the testa is membraneous, but in *Nepenthes*, the embryo is albuminous, while in *Podostemaceæ* it is exalbuminous. In both the embryo is decotyledonous, orthotropous, and with the radical directed towards the hilum. From this comparison, we find that the absence of albumen, and the difference in the connection of the stamens, are what principally distinguish *Podostemaceæ* from *Nepenthaceæ*. It will thus form the exalbuminous group of Lindley's second series of *Homogens*.

With *Aristolochiaceæ*, *Podostemaceæ* has also several points in common, as, indeed, might be expected from the near relation, which the former order bears to *Nepenthaceæ*

Lindley has alluded to a resemblance, which he conceives to exist between *Podostemaceæ* and *Lacistemaceæ;* a resemblance which is no doubt great, but not nearly so much so

as the one we have just traced, as a glance at their comparative structure will show. In *Lacistemaceæ*, the flowers are arranged in catkin-like spikes, each flower being subtended by a large bract. In the higher forms of *Podostemaceæ*, we find a somewhat similar disposition of the flowers, each of which emerges from the representative of the bract, a spathe. In both a calyx exists, and neither possess a corolla. In both the stamens are hypogynous, and unilateral, but not always so in *Podostemaceæ;* and in both the fruit is a 2 or 3-celled capsule. At this point, however, the resemblance ceases, for *Lacistemaceæ* has parietal placentæ, definite, albuminous seeds, and an inverted embryo, while in *Podostemaceæ*, the placentæ are attached to the dissepiments, the seeds are numerous and exalbuminous, and the embryo has the radical directed towards the hilum.

I can trace but little resemblance between *Podostemaceæ* and *Piperaceæ*, and still less between the former order and *Pistiaceæ;* notwithstanding that both Martius and Griffith insist on the close connection which exists between them.*

* Since the above was written, and while these sheets are with me for correction, I have received the new edition of Lindley's "Introduction to the Natural System," which now bears the name of "The Vegetable Kingdom." From the great mass of new matter which has been added to this edition, the great alteration which has been made in the arrangement, and from every order having one or more illustrations, beautifully executed, the work may almost be pronounced to be a new one; while from the value of the structural and systematical disquisitions which head the superior divisions of his mode of classification, it is not too much to say, that it is by far the most important contribution which has been offered to the literature of Botany since the publication of the now world-renowned "Genera Plantarum" of Jussieu.

In "The Vegetable Kingdom," I find that the Podostemons are arranged along with *Elatinaceæ* at the end of the Rutal allianæ, with the following observations:—"Although Podostemads must be considered to present a very strongly marked approach to flowerless plants in some respects, yet we must look for some more immediate relation. This I formerly thought might be found with Peppers or Callitriche; Meisuer suggests Hornworts *(Ceratophyllaceæ)*. But if we regard hermaphrodite flowers, hypogynous stamens, and an exalbuminous embryo as the most important features in these plants, our views of its affinity will take a very different direction, and we can scarcely fail to suspect an approach to water-

To the detailed descriptions of all the species of *Podostemaceæ*, which have as yet been found in India, I shall add characters of the order, and of the two Indian genera, in accordance with the views which I have taken of the structure of these plants. In the genus *Podostemon*, I find that the bracts or scales which surround the base of the spathe, afford excellent specific characters.

PODOSTEMACEÆ. *Lind.*

DAPSILOPHYTUM, *Necker Element. Bot. 2. p.* 245.—PODOSTEMONEÆ, *Richard in Humb. et Bonp. N. G.* 1. *p.* 246; *Martius N. G.* 1. *p.* 6; *Bartling Ord. Nat. p.* 72; *Arnott in the Ency. Brit. p.* 137; *Endl. Gen. Plant. p.* 268; *Meisner Vas. Gen. p.* 122 (88).—PODOSTEMACEÆ, *Lindl. Introd. ed.* 2. *p.* 190.—PHILOCRENACEÆ, *Bongard in Mem. Ac. Imp. Pet.* 6. *Ser.* 3. *p.* 72.

CHAR. *Perigonium* nullum vel triphyllum, foliolis distinctis, concaviusculis, membranaceis, imbricatis. *Stamen* unicum, duo vel indefinita, hypogyna: *filamenta* libera, vel basi inter se cohærentia, rarius in tubum coalita, compressa, acuta, nonnulla sæpius ananthera: *antheræ* introrsæ,

peppers *(Elatinaceæ,)* whose manner of life is in some respects similar. In fact, upon comparing the two orders, we find that they are otherwise much alike, except that the Podostemads are more incompletely formed in the floral envelopes, and seem to want the capitate stigmas of that order. Both have 2-celled anthers bursting inwards longitudinally, and a separable placenta bearing numerous anatropal seeds. It seems, therefore, probable that Podostemads stand in the same relation to water peppers *(Elatinaceæ)*, as Hippurads to Onagrads, and Lemnads to Arads." The following is the tabular view which he gives of the relations of the order.

Halorageæ.
Elatinaceæ,—PODOSTEMACEÆ,—Piperaceæ.
Marchantiaceæ.

The affinity traced between *Podostemaceæ* and *Elatinaceæ* is a very natural one, the two orders agreeing so well, particularly in their Carpological characters. A link in this direction was much wanted to connect the order with the more highly developed Exogens. From the above tabular view it will be seen, that

biloculares, ovatæ vel oblongæ, loculis oppositis, contiguis vel connectivo interposito sejunctis, sæpius disparibus, longitudinaliter dehiscentibus. *Pollinis* grannula globosa, vel interdum oblonga ad medium constricta. *Ovarium* liberum, globosum vel ellipticum, 2-3-loculare, placentis e loculorum angulo centrali late tumentibus. *Ovula* plurima, adscendentia, orthotropa. *Stylus* subnullus: *Stigmata* 2-3, integra vel bifida, decidua. *Capsula* costata, 2-3-locularis, septicide dehiscens, 2-3-valvis, valvis placentas in columnulum persistem coalitis nutantibus, æqualibus. *Semina* plurima, minima, in placentæ foveolis erecta, imbricata: *testa* crassa, cellulosa, mucilaginosa, integumento interiore membranaceo, bruneo. *Albumen* nullum. *Embryo* dicotyledoneus, orthotropus, albus, cellulosus: *cotyledonibus* duabus, plano, convexiusculis: *radicula* brevissima, umbilico proxima, infera. Herbae *aquaticæ, submersæ, plerumque annuæ.* Folia *alterna, fasciculata vel approximata et imbricata, in caule ramisque decurrentia et cum eo colliquescentia, tenerrima, integerrima vel laciniata, laciniis plerumque capillaribus, stomatibus destituta.* Stipulæ *nullæ.* Flores *parvuli, hermaphroditi vel abortu unisexuales, axillares vel terminales, solitarii vel aggregati, distiche spicati vel subracemosi.* Spatha *tubuloso-clavata, irregulariter rupta vel sub-di-triphylla, florem solitarium primum subsessilem includens, deinde flore in stipite plus minus longe elevato, pedicelli basim vaginans.*

Lindley connects it with the lower Exogens through *Piperaceæ*, an order which have some analogy with it, but, so far as I can see, but little affinity. I still consider that the affinities of the order in this direction is better represented through *Nepenthaceæ.* This order is now placed by Lindley in the Euphorbal alliance—an association which is evidently forced upon him by the principles which have guided him in the division of Exogens into sub-classes, viz. by following Jussieu in separating them into two unequal masses, one of which is declinous and the other hermaphrodite. This, which is doubtless a great improvement on the division adopted in the last edition, necessarily gives rise to many forced unions, of which the present is not the least glaring. No lineal arrangement of orders, however, will ever be free from such defects.

1. TRISTICHA, *Thouar.*

TRISTICHA, *Thouars Gen. Madag. n.* 8 ; *Presl in Rel. Hænk. p.* 86 ; *Endl. Gen. Plant. n.* 1836 ; *Meisner Vas. Gen. p.* 122 (88).—DUFOUREA, *Bory in Wild. sp. Pl.* 5. *p.* 55 ; *St. Hilaire in Mem. Mus.* 10. *p.* 471 ; *Spreng. Syst. Veg.* 1. *p.* 6 ; *Ræm. et Sch. Syst. Veg. Mantissa in Vol.* 1, *p.* 79. —PHILOCRENA, *Bonp. Mem. Ac. Pet.* 6 *Ser.* 3. *p.* 80. *t.* 6.

CHAR.—*Spatha* membranacea, diphylla vel caruoso-conica ad apicem aperta. *Flos* pedicellatus. *Perigonii* foliola 3, membranacea, concava, subimbricata, persistens. *Stamina* 1-3, hypogyna, foliolis perigonii alterna : *filamenta* libera, filiformia, indivisa : *antheræ* terminales, ellipticæ vel oblongo-lineares, biloculares. *Ovarium* 3-loculare. *Stigmata* 3, subulata, indivisa. *Capsula* costata, 3-locularis, 3 valvis, valvis a placenta centrali trigona, membranaceo-alata, solutis. *Semina* plurima, minima, imbricata, oblonga, obtusa : *testa* membranacea, brunea.—Herbulæ *annuæ, habitu muscorum vel hepaticarum quorundum, inter tropicos toties mundi in rivulis submersæ.* Caule *dichotomo-ramoso vel depresse suborbiculari.* Foliis *plurifarium imbricatis vel fasciculatis, semiorbicularibus vel linearibus, integerrimis vel minute enticulatis.* Floribus *solitariis.*

1. TRISTICHA CEYLANICA. *Gardn.*

T. frondibus suborbicularibus horizontalibus irregulariter lobatis, foliis fasciculatis parvis linearibus obtusis, floribus e parte superiore frondium exsertis, spathâ carnosâ conicâ echinatâ apice apertâ, capsulâ 9-costata.

HAB.—On smooth Gneiss rocks in rapids in the bed of the Mahawelle Ganga, below Peradenia, Ceylon. Fl. March.

DESCR.—*Fronds* suborbicular, horizontal, growing in large patches on the flat surface of rocks, irregularly and obtusely lobed, crustaceous, of a yellowish brown colour above, pale green beneath. *Leaves* in

small scattered crowded fascicles on the upper surface of the frond, linear, obtuse, scarcely a line long, of a pale reddish brown. *Flowers* solitary, arising from the upper surface of the frond. *Scales* none. *Spathe* fleshy, depressedly conical, echinate externally, open at the apex. *Pedicel* exserted, cylindrical, about 2-lines long, covered with a coat of pellucid cellular substance, which falls off after flowering. *Perigonium* of three equal, free, oblong, obtuse, somewhat concave, veinless segments, slightly imbricated in æstivation, of a greenish brown color, and about one line long. *Stamens* 3, hypogynous, alternating with the segments of the perigonium, exserted: *filaments* free, complanate, scarcely 1½-line long, all fertile: *anthers* elliptical, cordate at the base, obtuse, 2-celled, cells bursting longitudinally internally. *Pollen* yellow, globose. *Ovary* superior sessile, oblong, obtusely triangular, 3-celled, and coated with the same deciduous cellular substance as the pedicel. *Ovules* numerous, ascending. *Stigmata* 3-sessile, linear-oblong, obtuse, at length deciduous. *Capsules* obovate-oblong, obtuse, 9-sulcate, 3-celled, 3-valved, with a septicidal dehiscence. *Placentæ* attached to the dissepiments, forming a triangular body which ultimately becomes free. *Seeds* numerous, small, elliptical, obtuse, somewhat compressed.

Obser.—This very curious little plant differs in several respects from any of the published species of the genus, but essentially belongs to it. The most remarkable points connected with it are the broad, flat, horizontal, fronds, which extend widely over the rocks on which it grows, and often show dichotomous ramifications, the small fasicles of leaves, the very anomalous nature of the spathe, and the three stamens. It offers another proof that habit cannot be much depended on as a generic distinction among these plants.*

* In my Brazilian Herbarium, I find a new species of *Tristicha*, which I shall here describe; and being a normal species of the genus, the description may be useful to contrast with that of the Ceylon one.

TRISTICHA BRYOIDES. *Gardn.*

T. caule erecto ramoso, foliis imbricatis ellipticis vel elliptico-ovatis obtusis, pedicellis axillaribus, spathâ profunde bilobatâ lobis orbicularibus, capsulâ 9-costatâ.

Tristicha *bryoides, Gardn. Herb. Fl. Brazil. n.* 1844.

Hab.—On Gneiss rocks, and on small stones, in the bed of the Rio Salgado, near Icó, Province of Ceará, Brazil. In flower and fruit in September.

2. PODOSTEMON. *Rich.*

PODOSTEMON. *L. C. Richard in Michaux Fl. Bor. Amer.* 2. *p.* 164. *t.* 44; *Wild. Sp. plant.* 4. *p.* 196; *Pers. Syn. Pl.* 2. *p.* 532; *Kunth in Humb. et Bonp. N. Gen.* 1. *p.* 246; *Nutt. Gen. Am.* 2. *p.* 202; *Lindl. Nat. Syst. Ed.* 2. *p.* 442; *Griffith in As. Res.* 19. *p.* 103. *t.* 17; *Endl. Gen. Plant. n.* 1832; *Meisner Vas Gen. p.* 122 (88).—LACIS. *Mart. N. Gen.* 1. *p.* 5. *t.* 2; *Hook. Comp. Bot. Mag.* 2. *p.* 23. *t.* 20.—DICRÆIA, *Thouars Gen. Madag. n.* 4.—? NEOLACIS, *Cham. in Linnæa* 9. *p.* 504. *t.* 5.—HYDROBÆYUM, *Endl. Gen. Plant. n.* 1831, 1.

CHAR.—*Spatha* tubuloso-clavata, apice irregulariter rupta, basi bracteata. *Flos* pedicellatus. *Perigonium* nullum. *Stamina* 4, unilateralia: *filamenta* lateralia plano-setacea, abortientia, intermedia fere ad apicem coalita, fertilia: *antheræ* ovatæ, basi affixæ, biloculares. *Pollenis* granula

DESCR.—*Roots* whitish, fibrous, adhering to rocks and stones. *Stem* about an inch long, musciform, alternately branched, leafy. *Leaves* imbricated, sessile, alternate, elliptical or ovate-elliptical, obtuse, nerveless and veinless, about half a line long. *Flowers* solitary, lateral, springing from the axils towards the extremities of the branches. *Spathe* bivalvate, valves white, glabrous, distinct nearly to the base, orbicular, obtuse, about a line long. *Pedicel* cylindrical 4-5-lines long. *Perigonium* of three, equal, free, oval or somewhat obovate, obtuse, concave, veinless segments, which are imbricate in æstivation, and scarcely a line long. *Stamen* solitary, hypogynous, placed within and alternating with two of the segments of the perigonium: *filament* linear, about as long as the ovary: *anther* oblong, narrowed towards the apex, 2-celled, cells bursting longitudinally internally. *Pollen* globose, yellow. *Ovary* superior, sessile, obsoletely 9-sulcate, 3-celled, placentæ attached to the dissepiments. *Ovules* numerous, ascending. *Stigmata* 3, subulate, entire, divaricate, at length deciduous. *Capsule* elliptical, about three-fourths of a line long, deeply 9-sulcate, 3-celled. *Placentæ* attached to the dissepiments, forming a triangular body which ultimately becomes free. *Seeds* numerous, small, oblong, obtuse at both ends, ascending. *Testa* of a yellowish brown color. *Embryo* exalbuminous, dicotyledonous, orthotropous: *radical* inferior, directed towards the hilum.

OBSER.—This species appears to differ from *T. hypnoides*, Spr. (*Dufouria hypnoides*, St. Hil.,) by its larger size, and densely imbricated leaves, which are mostly of an elliptical shape, not triangular.

oblonga, ad medio constricta. *Ovarium* biloculare. *Stigma* sessile, bilobum, lobis plerumque inæqualibus. *Capsula* costata, bilocularis, bivalvis, valvis æqualibus, dissepimento placentifero libero alato-marginato parallelis. *Semina* plurima, minima, erecta, imbricata: *testa* crassa.—Herbulæ *annuæ (an semper?), habitu Fucorum vel Hepaticarum quorundum, in rivulis submersæ inter tropicos totius fere mundi.* Foliis *aut nullis aut paucis, rariter fasciculatis, linearibus, parvis, integris.* Floribus *solitariis vel congestis.*

1. PODOSTEMON GRIFFITHII. *Wall.*

P. frondibus orbicularibus depressis, floribus e parte superiore frondium exsertis, squamis 6, distichis imbricatis oblongis, spathâ bilobatâ, capsulâ 12-13-costatâ.

Podostemon *Griffithii, Wall. MSS. ex Griff. in Asiatic Researches Vol.* 19. *p.* 105. *t.* 17. *(right half.)*

Hab.—On rocks in the beds of streams in Assam. *Griffith.*

Descr.—*Plant* small. *Fronds* orbicular, firmly adhering to the rocks by their under surface, lobed, of a coriaceo-corneous texture, veinless, green, shining, and a little viscous. *Flowers* solitary, arising from the upper surface of the frond without order. *Scales* about 6, green, distichously imbricated, oblong, keeled, coriaceous. *Spathe* longer than the pedicel, the superior margin incised, the inferior entire, round. *Pedicels* short, included, covered with a coat of pellucid cellular substance, which ultimately falls off. *Floral envelopes* none. *Stamens* 4, hypogynous, unilateral and external with reference to the axis of the frond, the two lateral ones *abortive*, and about as long as the ovary, the two intermediate ones *fertile*, united nearly to the apex, each division bearing a single anther: *anthers* 2-celled, introrse. *Pollen* constricted in the middle. *Ovary* superior, nearly lanceolate, compressed, 1-line long, 2-celled, smooth. *Ovules* numerous: *style* nearly none: *stigmata* 2, cuneiform, dentate, fleshy, red, the external largest. *Capsule* subexserted, 12-13-costate, 2-celled, 2-valved, with a septicidal dehiscence. *Seeds* numerous, oblong, ovate, minute, ascending, attenuated at both ends: *testa* cellular, thick mucilaginous. *Embryo* dicotyledon-

ous, orthotropous, white: *cotyledons* plano-convex: *radical* inferior, directed towards the hilum: *plumule* inconspicuous.

Obser.—Of this species I have seen no specimen. The above description is translated and abridged from the detailed one in the volume of the Asiatic Researches referred to. The number of the costæ of the capsule distinguishes it easily from the two following species, to which it is otherwise nearly related.

2. PODOSTEMON OLIVACEUM. *Gardn.*

P. frondibus decumbentibus suborbicularibus lobatis olivaceis, floribus e parte superiore frondium exsertis, squamis 4 distichis imbricatis obtusis, spathâ longitudinaliter dehiscens glabriusculâ, 8-costatâ.

Hab.—On Gneiss rocks in the bed of the Massnawatte near Holnicut in the Ambegamoa district, in the Mahawelle Ganga below Peradenia, and above the waterfall at Rambodde, Ceylon. Fl. in February and March.

Descr.—*Fronds* horizontal, growing on the flat surface of rocks in large patches, irregularly and obtusely lobed, crustaceous, and of a dark olivaceous color. *Flowers* solitary, arising without order from the upper surface of the frond. *Scales* 6, distichously imbricated, the internal ones about 1-line long, oblong, obtuse, and keeled externally. *Spathe* clavate, green, about 1½-line long, bursting by a single slit, slightly scabrous externally under the lens. *Pedicels* cylindrical, about 1½-line long, covered with a coat of pellucid cellular substance, which falls off after flowering. *Floral envelopes* none. *Stamens* 4, hypogynous, unilateral, and external with reference to the axis of the frond, the two lateral ones *abortive*, setaceous, shorter than the two intermediate *fertile* ones, which are about 2-lines long, and united nearly to the apex, each fork bearing a single anther: *anthers* 2-celled, introrse, dehiscing longitudinally, the cells distinct, and the internal one about one-half smaller than the external. *Pollen* yellow, oblong, obtuse, constricted in the middle. *Ovary* superior, sessile, oblong, glabrous, green, covered with the same green cellular substance as the pedicel, smooth, 2-celled. *Ovules*

numerous, ascending. *Style* none: *stigma* sessile, fleshy, 2-lobed, the lobe opposite the stamens twice as large as the other, deciduous. *Capsule* elliptical, scarcely a line long, 8-costate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* flattened, attached to the dissepiment, the whole of which at length become free. *Seeds* numerous, small, ascending, ovate.

OBSER.—This species comes near the following, but is distinguished from it by its olivaceous, not grey, color, more numerous and larger scales, the nature of the spathe, and its smaller and less globose capsules.

3. PODOSTEMON GRISEUM. *Gardn.*

P. frondibus decumbentibus suborbicularibus lobatis undulatis griseis, floribus e parte superiore frondium exsertis, squamis 6, distichis imbricatis obtusis, spathâ sub-bivalvatâ scabrâ, capsulâ 8-costatâ.

HAB.—On rocks in the bed of the Pycarrah river, Neilgherry Mountains, Peninsula of India. *Wight* and *Gardner.* Fl. February.

DESCR.—*Fronds* suborbicular, attached by their under surface to the rocks on which they grow, irregularly lobed, the lobes oblong or obovate, over-lapping each other, and forming large Lichen-like patches, of a coriaceo-crustaceous texture, and greyish green color. *Flowers* solitary, arising without order from the upper surface of the frond. *Scales* about 6, small, distichous, imbricated, obtuse, scaphoid. *Spathe* clavate, tubular, membranous, scabrous externally, about 2-lines long at the time of flowering, bursting by 2-valves at the apex, and ultimately splitting nearly to the base on one side. *Pedicels* cylindrical, at the time of flowering about 1½-line long, but ultimately becoming a little longer, covered with a coat of pellucid cellular substance, which falls off after flowering. *Floral envelopes* none. *Stamens* 4, hypogynous, unilateral, and external with reference to the axis of the frond, the two lateral ones *abortive*, complanate, setaceous, the two intermediate ones *fertile*, 1½-line long, united nearly to the apex, each fork bearing a single anther: *anthers* 2-celled, introrse, dehiscing longitudinally, cells distinct anteri-

orly, but connected behind by a thin cellular connective, the external one about twice as large as the internal. *Pollen* yellow, slightly constricted in the middle. *Ovary* superior, sessile, ovate, glabrous, obtusely 8-sulcate, 2-celled. *Ovules* numerous, ascending: *style* none: *stigma* fleshy, deeply and unequally 2-lobed, lobes divaricate, acute, at length deciduous. *Capsule* about 1-line long, oval, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* flattened, attached to the dissepiment, the whole of which at length become free. *Seeds* numerous, small, ascending, oblong; *testa* of a brownish colour, membranous, mucilaginous when moistened. *Embryo* dicotyledonous, orthotropous: *radical* inferior directed towards the hilum.

4. PODOSTEMON WALLICHII. *R. Br.*

P. frondibus flabelliformibus irregulariter lobato-ramosis, floribus e parte superiore frondium exsertis submarginalibus, squamis 5-7 distichis imbricatis ovatis subangulatis obtusis, spathâ irregulariter lobatâ glabrâ, capsulâ 8-costatâ.

Podostemon *Wallichii, R. Br. in Wall. Cat. n.* 5225; *Griffith in Asiatic Researches* 19. *p.* 103. *t.* 17. *(left half)*.

Lacis *Wallichii, Stend nom. Bot.* 2. *p.* 2; *Dictr. Syn. Plant.* 3. *p.* 272.

Hab.—Mountains of Sylhet, *Gomez.* On rocks and stones at the cataract of *Churrapunje* near Moosmai and Mamloos in Assam, *Griffith.* Fl. October.

Descr.—*Frond* somewhat flabelliform, ascending, irregularly lobed, of a coriaceo-cartilaginous texture, and about one inch long. *Flowers* solitary, arising from the margins of the upper surface of the fronds. *Scales* 5-7 distichous, imbricated, of an irregular angular shape. *Spathe* tubular, dilated at the apex and irregularly lobed, glabrous. *Pedicels* cylindrical, flexuose before the bursting of the spathe, at length about 4-lines long, covered with a coat of pellucid cellular substance which falls off after flowering. *Floral envelopes* none. *Stamens* 4 (sometimes 5 according to Griffith) hypogynous, unilateral, the lateral ones *abortive*, plano-setaceous, subspathulate at the apex; the two intermediate ones *fertile;* a little longer than the ovary, subterete, united nearly to the apex, each fork bearing a single anther: *anthers* broadly ovate, fixed

by the base, 2-celled, subdidymous, dehiscing longitudinally internally. *Pollen* constricted in the middle. *Ovary* superior, sessile, ovate, glabrous, 8-sulcate, 2-celled. *Ovules* numerous, ascending. *Style* nearly none: *stigma* fleshy, at length deciduous, deeply 2-lobed, lobes conico-subulate, unequal, divaricate. *Capsule* ovate, about 1-line long, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* complanate, adhering to the dissepiment, all of which ultimately become free. *Seeds* numerous, small, ascending, ovate: *testa* thick, mucilaginous when moist. *Embryo* exalbaminous, orthotropous: *cotyledons* plano-convex: *radical* inferior, directed towards the hilum, obtuse, twice longer than the cotyledons: *plumule* inconspicuous.

Obser.—Of this species I have a fine set of specimens in fruit from Dr. Wight, who received them from Griffith. It is very distinct from any of the species with which I am acquainted, and forms a transition from the foregoing species to those which follow. The fronds are nearly erect, very much abbreviated, the branches broad, and the flowers though they arise from the disk, are somewhat marginal.

5. PODOSTEMON SUBULATUM. *Gardn.*

P. frondibus rigidis erectis teretibus dichotomo-ramosis, ramis dense floriferis, floribus distichis, squamis solitariis valde elongatis subulatis coriaceis, spathâ 3-4-lobatâ scabrâ, capsulâ 8-costatâ.

Hab.—On stones in the bed of the Mahawelle Ganga, near Holnicut, district of Ambegamoa, Ceylon. Fl. February.

Descr.—*Fronds* coriaceous, cylindrical, erect, dichotomously branched, one or two inches long. *Flowers* distichous, closely imbricated, each subtended by a single subulate coriaceous scale about three inches long, of a brownish colour, and with a dilated sheathing base. *Spathe* clavate, scabrous, about 3-lines long, irregularly 3-4-lobed at the apex. *Pedicels* at length 3-4-lines long, covered with a coat of pellucid cellular tissue, which falls off after flowering. *Floral envelopes* none. *Stamens* 4, hypogynous, unilateral, the two lateral ones *abortive*, setaceous, complanate, and about two-thirds shorter than the intermediate ones, which

are *fertile*, about 4-lines long, and united nearly to the apex, each fork bearing a single anther: *anthers* 2-celled, introrse, dehiscing longitudinally, the cells oblong, disunited, nearly of the same size. *Pollen* yellow, constricted in the middle. *Ovary* superior, sessile, glabrous, covered with a greenish cellulur substance similar to that on the pedicel, 8-sulcate, 2-celled. *Ovules* numerous, ascending. *Style* none. *Stigma* equally 2-lobed, lobes linear, acute. *Capsule* obovate, 1½-line long, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* flattened, attached to the dissepiment, the whole of which at length become free. *Seeds* numerous, ascending, ovate.

OBSER.—A very remarkable, and most distinct species, easily recognised by the solitary, subulate, and much elongated scale.

6. PODOSTEMON DICHOTOMUM. *Gardn.*

P. frondibus linearibus complanatis dichotomo-ramosis, ramis versus apicem attenuatis, floribus marginalibus, squamis paucis oblongo-lanceolatis longe acuminatis, spathâ *2-3*-lobatâ glabrâ, capsulâ 8-costatâ.

HAB.—On rocks in the bed of the Pycarrah River, Neilgherries, *Wight* and *Gardner*. Fl. in February.

DESCR.—*Roots* capillary. *Fronds* linear, much attenuated upwards, dichotomously branched, about six inches long, and of an olivaceous colour, leafless. *Flowers* solitary, marginal. *Scales* few, the two internal ones oblong-lanceolate, accuminate, and connate at the base, about 1-line long, the external ones linear, complanate, of the same length. *Spathe* clavate, about 1½-line long, membranous, glabrous, 2-3-lobed at the apex. *Pedicels* cylindrical, curved downwards at the time of flowering, and about 2½-line long, but ultimately becoming straight, and from 6-9-lines long, covered with a thin coat of pellucid cellular substance, which falls off after flowering. *Floral envelopes* none. *Stamens* 44, hypogynous, unilateral, the two lateral filaments *abortive*, complanate, setaceous, and about two-thirds as long as the two intermediate ones, which are *fertile*, about 1-line long, united nearly to the apex, and forming a linear complanate column, each fork of which bears a single anther: *anthers* 2-celled, introrse, dehiscing longitudinally, the cells dis-

tinct anteriorly, but connected behind by a cellular connective, the internal one smaller than the external. *Pollen* yellow, oblong, constricted in the middle. *Ovary* superior, sessile, ovate, glabrous, covered with the same deciduous cellular tissue as the pedicel, and falling off along with it, obsoletely 8-sulcate, 2-celled. *Ovules* numerous ascending. *Style* none: *stigma* sessile, deeply 2-lobed, lobes ovate, obtuse, at length deciduous. *Capsule* elliptic-oblong, about 1-line long, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* flattened, attached to the dissepiment, the whole of which at length become free. *Seeds* numerous, small, ascending, flattened, elliptic or elliptic-oblong: *testa* membranaceous, mucilaginous when moistened, and of a yellowish brown colour. *Embryo* dicotyledonous, exalbuminous, orthotropous: *radical* inferior, directed towards the hilum, obtuse, shorter than the cotyledons.

Obser.—This is well distinguished from any of the other species by its slender linear fronds, which are generally branched dichotomously. The scales which surround the base of the pedicel most nearly resemble those of the following species, but they are much fewer in number, broader, and not so long. It is further distinguished from it by the fronds not being flexuose, and of a less coriaceous texture.

7. PODOSTEMON WIGHTII. *Gardn.*

P. frondibus linearibus complanatis flexuosis ad basim ramosis, floribus marginalibus, squamis numerosis setaceis valdè elongatis, spathâ irregulariter lobatâ glabrâ, capsulâ 8-costatâ.

Hab.—On rocks in the bed of the Pycarrah River, Neilgherries, *Wight.* Fl. in February.

Descr.—*Fronds* linear, complanate, flexuose, branched at the base about four inches long, coriaceous, and of an olivaceous colour, leafless. *Flowers* solitary, marginal. *Scales* numerous, imbricated, flattened, setaceous, 4-6-lines long. *Spathe* irregularly lobed, glabrous. *Pedicel* cylindrical, flexuose at the time of flowering, and about 2-lines long, but ultimately extending to 6-lines, covered with a thin coat of pellucid cel-

lular tissue, which falls off after flowering. *Floral envelopes* none. *Stamens* 4, hypogynous, unilateral, the two lateral filaments *abortive*, complanate, and more than a half shorter than the intermediate ones, which are *fertile*, about 1-line long, and united nearly to the apex, forming a linear column, each fork of which bears a single anther: *anthers* 2-celled, introrse, dehiscing longitudinally, the cells disunited anteriorly, but connected behind by a thin cellular connective, the internal one smaller than the external. *Pollen* yellow, constricted in the middle. *Ovary* superior, sessile, glabrous, covered with the same kind of cellular tissue as the pedicel, obsoletely 8-sulcate, 2-celled. *Ovules* numerous, ascending. *Style* none: *stigma* sessile, deeply 2-lobed, lobes unequal, persistent. *Capsule* oblong, 1½-line long, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* flattened, attached to the dissepiment, the whole of which at length become free. *Seeds* numerous, small, ascending.

Obser.—The characters by which this species may be readily distinguished from the preceding one, have already been pointed out. The only other with which it may be confounded is the following one, but the nature of the scales will immediately settle the point, they being so numerous and so long in the present plant, as to give it the appearance of being covered with fascicles of setaceous leaves, while in the other they are very short and obtuse.

8. PODOSTEMON RIGIDUM. *Gardn.*

P. frondibus linearibus complanatis versus basim ramosis, floribus marginalibus, squamis paucis distichis imbricatis ovatis vel ovato-oblongis obtusis, spathâ irregulariter lobatâ glabrâ, capsulâ 8-costatâ.

Hab.—On rocks in the bed of the Pycarrah River, Neilgherries, *Wight* and *Gardner*. Fl. in February.

Descr.—*Fronds* linear, complanate, straight, branched at the base 4-5-inches long, coriaceous, of an olivaceous colour, leafless. *Flowers* marginal. *Scales* 3-4, distichous, imbricated, ovate, or ovate-oblong, obtuse, about 1½-line long. *Spathe* clavate, membranous, glabrous,

bursting irregularly at the apex, about 1½-line long. *Pedicels* cylindrical, curved upwards at the time of flowering, and about 2½-lines long, but ultimately extending to 5-lines, covered with a thin coat of pellucid deciduous cellular tissue. *Floral envelopes* none. *Stamens* 4, hypogynous, unilateral, the lateral filaments *abortive*, complanate, setaceous, a little more than half as long as the two intermediate ones, which are *fertile*, about 1-line long, united nearly to the apex, and forming an oblong-linear column, each fork of which bears a single anther: *anthers* 2-celled, introrse, dehiscing longitudinally, the cells oblong, disunited anteriorly, but connected behind by a thin cellular connective, the internal one smaller than the external. *Pollen* yellow, oblong, very much constricted in the middle, ovary superior, sessile, glabrous, covered with the same deciduous cellular tissue as the pedicel, obsoletely 8-sulcate, 2-celled. *Ovules* numerous, ascending. *Style* none: *stigma* sessile, deeply 2-lobed, lobes unequal, at length deciduous. *Capsule* oval, about 1-line long, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* flattened, attached to the dissepiment, the whole of which ultimately become free. *Seeds* numerous, ascending.

Obser.—This species resembles *P. dichotomum* in habit, but is a less branched, and far more robust plant. Before the spathe bursts, the whole plant very much resembles a large *Sertularia*. The nature of the scales will prevent it from being confounded with any of the other species.

9. PODOSTEMON ELONGATUM. *Gardn.*

P. frondibus cylindrico-capillaribus valde elongatis parce ramosis, foliis fasciculatis complanatis setaceis, floribus marginalibus, spathâ irregulariter lobatâ glabrâ, capsulâ 8-costatâ.

Hab.—On rocks in the bed of the Massnawatte near Holnicut in the Ambegamoa district, and in rapids in the Mahawelle Ganga below Peradenia, Ceylon. Fl. February and March.

Descr.—Fronds cylindrical, capillary, six inches to two feet long, sparingly branched, coriaceous, and of a dark olivaceous colour. *Leaves* in

small fascicles towards the extremities of the fronds, flattened, setaceous, 2½-3-lines long. *Flowers* marginal, solitary. *Scales* 4-5, distichous, imbricated, scaphoid, obtuse, from 2-3-lines long. *Spathe* clavate, glabrous, bursting irregularly at the apex, about 1½-line long. *Pedicels* cylindrical, 3-lines long, covered with a thin coat of deciduous cellular tissue. *Floral envelopes* none. *Stamens* 4, hypogynous, unilateral, the two lateral filaments *abortive,* setaceo-complanate, nearly a half longer than the intermediate ones, which are *fertile,* and united nearly to the apex, forming a linear column about 2-lines long, each fork of which bears a single anther: *anthers* 2-celled, introrse, dehiscing longitudinally, cells oblong, disunited, the internal one a little shorter than the external. *Pollen* yellow, constricted in the middle. *Ovary* superior, sessile, glabrous, covered with the same deciduous cellular tissue as the pedicel, obsoletely 8-sulcate, 2-celled. *Ovules* numerous, ascending. *Style* none: *stigma* sessile, deeply 2-lobed, lobes divaricate, at length deciduous. *Capsule* oblong, about 1½-line long, deeply 8-sulcate, 2-celled, 2-valved, with a septicidal dehiscence. *Placentæ* flattened, attached to the dissepiment, the whole of which at length become free. *Seeds* numerous, ascending, small, flattened, roundish: *testa* membranous, mucilaginous when moist, of a yellowish-brown colour. *Embryo* exalbuminous, dicotyledonous, orthotropous: *radical* inferior, directed towards the hilum, shorter than the colyledons.

Obser.—A very different species from any of the other Indian ones, being remarkable from the great length of the slender fronds, which, when a mass of them are together, resemble the tail of a horse, and from the existence of leaves which occur in fascicles towards the extremities of the fronds. The capsule frequently only splits on one side.

Kandy: 19*th April,* 1846.

Notes on the Military Stations and the health of Troops in Arracan, with some Statistical Returns. *By* JOHN MACPHERSON, M. D.

At the close of the Burmese war several of the Company's Medical Officers published ample accounts of their experience of Arracan and of its deadly fever. But since the appearance at that time of the papers of Messrs. Grierson, Burnard and Stevenson, no contribution of any importance had been made to our knowledge of the medical topography of Arracan, until the appearance of Dr. Archer's paper in the last No. of this Journal. Major Tulloch's short report on Arracan, in his last volume of returns, forms no exception to this statement; as it adds nothing to the facts recorded by Mr. Burnard, on whose excellent paper it appears to be based.

As great changes have taken place of late years in the province, it is proposed with the aid of what has been already written, and of some personal knowledge of portions of the country, to give a slight sketch of its topography, and some account of its climate and the health of troops stationed in it, along with a few tables, compiled from such scanty returns as the kindness of the Secretary to the Medical Board has rendered available.

I.—TOPOGRAPHY.

General description.

The province of Arracan is a narrow strip of land, the breadth of which varies from thirty to fifty miles. Its extreme length from Chittagong to Cape Negrais, from lat. 20° 30′ to 15° 53′, may be considered 400 miles: on the east, it is separated from Burmah by a range of mountains varying from 2,000 to 5,000 feet in height, probably consisting of gneiss, which run nearly north and south, but gradually approach the coast as they extend southwards: on the west, its shores, which are generally rocky, consisting of sandstone with a cincture of live

coral or of coralline limestone, are washed by the Bay of Bengal.

The nature of the soil varies much:—in some places it is low, marshy, and overrun with jungle, in some sandy, and in others a rich loam.

The whole of the district is hilly and wooded, and broken up by sandstone ridges frequently containing traces of coal, and in some instances crowned by mud volcanoes,* which are generally quiescent, but with occasional seasons of activity, and are the most distant off-shoots of the volcanic chain of the Moluccas. The country is every where intersected by salt water nullahs and jheels, and in most places covered with luxuriant vegetation. The chief rivers are the Myhoo, Kaladyne and Lemroo, the Aeng, and the Sandoway: most of them wind their way into the sea through innumerable swampy islands and the densest forests of mangrove: and their banks near their mouths are covered with a rankness of vegetation which can scarcely be imagined, by those who have not seen the Sunderbuns, or the mouths of other tropical rivers. They are all greatly under the influence of the tides, and their banks, and those of the nullahs connected with them, are low and shelving, and covered with mud, which is exposed at low water.

Islands.

There are numerous hilly islands, of which Ramree and Cheduba are the chief of the larger, and Akyab and Juggoo of the smaller class. They are all however very close to the main land, and Cheduba alone can be regarded as possessing in any degree an insular climate.

Yet at the close of the Burmese war, when from the healthiness of a detachment of the 40th N. I. long stationed on it, it had acquired a character for salubrity, at least 200

* The mud volcanoes are generally surrounded by casuarina trees, though there may be no others in the neighbourhood.

men of the European Regiment (which was sent to the province to relieve the remnants of H. M's. 54th and 44th Regiments,) fell victims to fever in this island, which might have been expected to be as healthy as it is picturesque. It too contains mud volcanoes, and displays several raised beaches.

All the stations now occupied by Europeans, or as posts for troops, lie within a space of about 140 miles, extending from Akyab southwards to Sandoway. Still it may not be out of place to quote here a short description of the old town of Arracan, although it is farther north and beyond these limits, and has long been abandoned by us owing to its excessive unhealthiness.

Arracan Town.

"The town of Arracan lies on the banks of a muddy river, buried among the hills, at a distance of nearly forty miles from the sea, and invested on every side with jungle and morass. The tide overflows the flat borders of the river to a considerable extent: its reflux converts them into a noisome swamp; and in this swamp, strange to say, great part of the town of Arracan is built: the water flowing under the houses, which are raised on posts after the fashion of the Burmese, Malays, and other Eastern nations. The banks of the stream throughout the town are low and covered with sedge, coarse grass, and a few bushes, serving as a receptacle for filth of every description. About a quarter of a mile from the town of Arracan is a large lake winding for several miles among the hills, full of weeds, with low and marshy banks."

In such a locality we do not wonder at the health of troops suffering excessively in temporary barracks, although we shall have an opportunity of seeing that troops encamped on an open sandy plain, afterwards suffered in exactly the same way, and if they had remained longer, would have suffered nearly in the same degree. Yet the Oondyne stockade, situated only a mile and a half from the centre of the fort of Arracan, appears to have been still more unhealthy. It is thus described—

"It lies low between the hills and the river, with a plain to the SW. and SSW., the greater part of which is uncultivated, and produces a luxuriant crop of rank grass, intersected by different streams of the tide-nullah, and daily covered by the tides." It does indeed seem strange how two such spots could have been selected for the residence of European or Native troops, even for a few months.

Akyab.

When it was found necessary to abandon the post of Arracan, Akyab was selected for the head quarters of the civil authorities and of the local battalion. It is built on the island of the same name, at the mouth of the Arracan river, and is thus close to the sea. It has been rapidly rising in importance and its extent proportionally increasing, since it has become a place of commerce, and the chief port for the exportation of rice, the great staple of the province. It is situated on a loose sandy soil, having an elevation little beyond high-water mark, and in parts liable to be inundated every spring tide; bounded on three sides by jungle, jheel, and marsh; and on the fourth by an estuary, which at low-water leaves in many places a beach of stagnant mud, often supporting a thicket of mangroves, with the wind blowing for nearly half the year over hundreds of miles of unexplored jungle previous to reaching the station. The town is intersected by dirty nullahs. In many places the houses are built too close together, the drainage is imperfect, the vegetation too rank, and the rain water collected by the natives in holes, dug for the purpose of receiving it, is muddy and brackish, and the common drink of the inhabitants. Notwithstanding that, under the rule of the present active Commissioner many of these evils are being obviated,—sickness would appear according to Dr. Archer to be greatly on the increase in Akyab. It is probably owing to these causes that the station has been so unhealthy to the local battalion, and that on the whole, fever is much more common among Europeans at Akyab than at Khyouk Phyoo. Europeans frequently

resort to the latter place for change of air, although they have the advantage of a sanatorium bungalow built on a rocky point, which runs out into the sea about two miles from Akyab.

Aeng.

The same reasons which led to the abandonment of the town of Arracan, lead to the transference of the civil head quarters of Aeng to Khyouk Phyoo, the nearest station to the south of Akyab. We believe that three Assistants to the Commissioner died successively at Aeng, in 34, 35, 36, before the transference took place. It is situated on the Aeng river at no great distance from the foot of the well known pass into Burmah of the same name, and continues to maintain its reputation as a hot bed of fever; for on a very late occasion it proved fatal to a young officer who had accompanied one of the senior Assistants on a visit to it.

Khyouk Phyoo.

The sandy plain on which Khyouk Phyoo is built, is separated from the rest of the island of Ramree, on one side by a salt creek, on another by a low range of sandstone hills, while on the other two sides it is encircled by the sea: it is to a considerable extent embayed, as a range of broken woody islands to its east shuts it out from Combermere bay and the open sea. A few years ago this plain was covered with the most dense jungle, but this has been cleared away for more than a mile inland. The process of clearing seems to have been carried to an unnecessary extent, as only a few Gurjun trees have been left standing, and there is no shade. It is a curious fact that the health of the N. I. corps at this station does not seem to have borne any distinct relation to the progress of clearing.

The whole station may be considered nearly level, after making allowance for one or two lines of drainage and small salt jheels which intersect it. It is on the whole well drained, and the soil is exceedingly dry during the hot and cold seasons, though during the rains much water must accumulate on the surface.

There are no tanks as in Bengal, but water is readily obtained by sinking wells 30 or 40 feet through the sand and a bluish clay which lies beneath it. The water is necessarily impregnated with salt.

Khyouk Phyoo has long been the head quarters of the N. I. corps in the province. The native town is built with regularity, and is fully a mile apart from the lines and the bungalows of the officers. Their bungalows are built along the sea-shore, are all raised on piles, and generally glazed and comfortable: they enjoy the full benefit of the sea breeze. The lines have been lately rebuilt and are also raised on piles: they are admirable, and situated about half a mile from the sea: about a quarter of a mile further back is the hospital, which was a spacious well-raised building with glazed windows, but unfortunately placed on the lowest piece of ground which it was possible to select, and where the fog always lies heaviest and longest in the morning. On the recent occasion of the hospital being burnt down, and its having to be rebuilt, it might have been hoped that a better site would have been adopted. Probably the best site for a hospital is the rising ground about half-way between the lines and the native town, on which the jail is placed. Great improvements have of late been made in the jail, and the buildings have been made puckah; the filthy huts of burkandauzes, which surrounded it, have also been removed.

On the side of the creek a nasty salt jheel runs up to within about a mile of the back of the station. It is probably impossible to do much in the way of improving it, but the wind very rarely blows from this quarter.

A review of the localities of Khyouk Phyoo gives the impression that it ought to be an excellent station for troops; some regiments have of late years been quite healthy, as are Europeans in general; yet at times it has been exceedingly unhealthy both to Europeans and to natives. The mortality of the station seems, however, never to have exceeded,

indeed has never equalled that which frequently occurred a few years ago in a N. I. corps during its second and third year at Barrackpore.

Ramree.

Ramree, the head-quarters of another of the Assistants, is situated about 40 miles from Khyouk Phyoo on a small stream about eight miles from its mouth, in the centre of wooded hills. It has the reputation of being hot, moist, and unhealthy, and for this reason goes commonly by the name of the "Devil's punch bowl." There are no means of judging of the effect of its climate on troops, as of late years only a few guards have been detached to it from Khyouk Phyoo and Akyab.

Sandoway.

The most southerly station occupied by us is Sandoway, which stands on a rich red coloured alluvial soil in the valley, and on the river of the same name, about eight miles from its mouth. The native town is on one side of the river, and the military cantonment is on the other. The neighbouring fertile plain famous for the tobacco which it produces, is in general well drained, and is encircled by exceedingly beautiful wooded hills, most of them crowned with Pagodas. This lovely valley seems at all times to have been particularly healthy: formerly a whole regiment used to be stationed here, but of late years there have been seldom more than one company of sepoys and two of Mughs.

II.—Climate and Health of Troops.

Climate.

The chief characteristic of the tropical climate of Arracan, is the immense fall of rain during a portion of the year: it is generally found to be pleasanter to the feelings of an European than that of Bengal, although the rays of the sun are commonly declared to be more powerful. The climate of the whole eastern coast of the Bay of Bengal appears to be wonderfully uniform as to all essentials, and this makes the contrast between the extreme healthiness of Moulmein, and the reported unhealthiness of Arracan the

more striking. The seasons in Arracan may, in a general way, be divided into the dry and the wet, as the dry season can scarcely be divided into the hot and the cold; for the cold weather is seldom of more than six weeks' duration.

Rain seldom falls in any quantity between May and October, the first and last months of the wet season. The average quantity of rain throughout the year may be stated at 200 inches, which fall chiefly in June, July, August, and September, especially in the two first months.

In the cold, and in the early part of the hot season, very heavy dews fall at night, and dense fogs are common in the morning, often not clearing away till 9 A. M.

The thermometer seldom rises above 90° in the hot or above 75° in the cold weather. During the rains the daily average of the thermometer is about 75°, and in the cold weather 56° is about the lowest point to which it sinks.

At almost all times of the year, and even during the incessant rains of the wet season, the sea breeze during the day is very refreshing. The monsoons are much the same as in the other parts of the Bay of Bengal.

Mughs.

The Mughs, the inhabitants of the country, are a stout muscular people, of Mongolian race, resembling the Burmese in all essentials, but said to be commonly shorter men. They always raise their huts several feet above the ground. Their diet is multifarious enough, but fish and rice are its chief articles. They appear on the whole to be a healthy race, though cholera and small-pox,* have of late years committed fearful ravages among them. Fevers, enlargements of the spleen, and dysentery, appear to be their most common complaints.

Arracan Local Battalion.

Yet if we are to judge of the healthiness of the natives by the Local Battalion, we shall not be inclined to form a very favourable opinion of it for on examining table No. I. it will be found, that (even

* Mr. Andrews, Civil Surgeon of Ramree, was for some years very active and successful in inducing the people of his district to be vaccinated.

after deducting deaths caused by the epidemics of cholera and small-pox) the mortality far exceeds the average of that of troops serving in their own country, and is much greater than even that of Europeans at Moulmein. It must however be remembered, that many men are always detached on duty, frequently at unhealthy out-posts, and also that a good many men are from Munipore, and are not strictly Rakains or Mughs.

Chittagong men.

A great many natives of Chittagong are employed in Arracan as servants and coolies, and from the general resemblance of the climates of the two provinces, it might have been conjectured, that they would not suffer in the same degree as the up-countrymen. Yet they appear to suffer much in the same way as the sepoys do.

Europeans.

As no body of European troops has been of late years stationed in Arracan, we have no means of judging fairly of its effect on Europeans when well housed, but some years ago when a detachment of European Artillery was at Khyouk Phyoo, no casualty occurred during a stay of seven months among them or the rest of the European population, which amounted in all to about 150.

Sepoys.

The effect of the climate of Arracan on the sepoys, when injurious, is analogous to that produced on them by the climate of Bengal; and according to the length of stay of the regiment, the amount of the sickness seems in either case to increase, in both cases, fever and its sequelæ breaking down the constitution. There is nothing peculiar in the fever of Arracan, that is, nothing that is not constantly met with in similar localities, and it would be waste of time to describe here afresh its symptoms or its progress.

But before examining the appended Tables, and making a few deductions from them, it may be interesting to contrast the history of two regiments stationed at the same place, treated in the same hospital by the same medical officer, yet suffering in very different degrees, and doing so from very obvious causes.

68th N. I.

The 68th N. I. had been for several years a healthy corps: it was in the cold weather of 1840-41 ordered down from Allahabad to the presidency, whence it was conveyed by sea to Khyouk Phyoo, none of the vessels making a long passage. It continued healthy on the way down, and immediately went into good lines, (i. e. better than those at Barrackpore, though not so good as the admirable new lines which are built on raised muchauns.) The climate agreed so well with this corps, that the men did not lose 2 per cent. per annum, and indeed became fat, as proved incontrovertibly by most of them having to get their clothes let out.

47th N. I.

The 47th N. I., in the beginning of 1841, its second year at Barrackpore, suffered very severely losing forty men in four months. It left Barrackpore on the 14th of October 1841, and was encamped for about a week at Balloo Ghat during most oppressive weather. The men, a great proportion of whom were young, were then crowded into transports, most of which made a tedious voyage of about sixteen days to Khyouk Phyoo; a few men died on the way down, and many men, especially Hindoos, who eat hardly any thing on board-ship, landed in a very feeble state.

Nature of encampment.

On their arrival, they were very properly encamped (there being no lines for them,) near the sea beach, in an airy situation, and on a dry sandy piece of ground, with their tents pitched over raised muchauns. It would be impossible to select any piece of ground less exposed to any obvious malarious influences.

At first their admissions into the 68th hospital to which they were sent, were few, chiefly cases of debility, and occurring in *young* men, as indeed was the case all along. Slight cases of fever began to be common; the patients were cured of their fevers, but did not regain their strength.

Progress of sickness.

Towards the middle of January, the number of sick increased to upwards of a 100, and diarrhœa and dysentery of the most obstinate kind became the common sequelæ of the fevers. Sloughing of the cornea with destruction of vision, and sudden and extensive dropsy of the scrotum also became frequent.

There was found at the same time, to be an increase in the number of sick in the 68th, and in the jail, though it was comparatively small.

The men still remained in camp and in February, and after they began to die, Nostalgia began to prevail to a considerable extent, and no wonder that it was so, as they were constantly deluded by the expectation of the immediate arrival of transports. From this time the number of deaths continued to increase, and almost equalled that which occurred the year before at the same season at Barrackpore, and no improvement took place up to the period of the corps leaving Arracan in May, (vide Table No. 3.) But the deaths were all among the younger men, under 30 years of age.

Meantime, the mortality in the 68th was very small; in fact, for three months they did not lose a single man.

Most obvious causes.

The most obvious causes of the 47th suffering so much, appear to have been the following:—1st, the men remained for six months in a standing camp, which always after a time becomes unhealthy;—2nd, they were particularly exposed to the cool sea breeze, which was too much for sepoys, though bracing to an European constitution;—3rd, the vicissitudes of temperature in the unsheltered tents, when there was a powerful sun during the day and heavy fogs at night, were very great;—4th, from the sandy nature of the soil, it was difficult for the men to cook their food, without a quantity of sand getting into it; —5th, the parades were too frequent, especially for a corps containing so many young men;—6th, that malaria may have

had something to do in producing these fevers is possible, but there was no obvious source for its production. The soil was quite dry, and no rain fell till after the men had been suffering for months from fever.

TABLE No. I.

Shewing Deaths in the Arracan Local Battalion—average strength 830—*and the number of Deaths in different months from* 1838 *to* 1844.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.		
1838	—	—	—	1	1	2	3	1	5	3	2	2	20	Regimental Returns.
1839	—	—	3	5	20	8	2	1	2	1	—	1	43	
1840	3	2	1	—	—	1	8	5	1	2	2	2	27	
1841	—	2	3	—	21	10	1	2	2	—	1	1	43	
1842	—	—	1	2	—	—	1	—	1	—	2	1	8	Superintending Surgeon's Returns.
1843	1	1	—	2	4	1	2	10	—	3	8	14	46	
1844	11	12	—	10	4	1	1	2	1	1	1	—	44	
Total,	15	17	8	20	50	23	18	21	12	10	16	21		
Total,	1st period 60				2d ditto 112				3d ditto 59					

And deducting epidemics of cholera and small-pox—

1st period 27. | 2nd ditto 55. | 3rd ditto 33.

TABLE No. II.

Table of the relative Mortality in the Assam Light Infantry, Sylhet Light Infantry, and Arracan Local Battalion.

Years.	Arracan Local Battalion, Strength 700.	Assam Lt. In. Strength 1000	Sylhet Lt. In. Strength 940.	
Deaths in 1838	19	26	—	Superintending Surgeon's Returns.
„ 1839	37	50	11	
„ 1840	20	25	6	
„ 1841	34	27	9	
„ 1842	8	26	4	
„ 1843	46	30	3	
„ 1844	44	45	6	

Head Quarters of Arracan Local Battalion, Akyab, mortality 4.1 per cent.

——————— Assam Light Infantry, Bisnath „ 3.2 „

——————— Sylhet Light Infantry, Cheera „ .7 „

N. B.—For the years 1843 and 1844 the strength of the Sylhet Light Infantry was only 690, the left wing being detached to Cachar, where it has been much less healthy than the Head Quarters at Cheera.

TABLE No. III.

Table shewing contrast between the 68th and the 47th N. I.

Corps.	Strength.	January.	February.	March.	April.	May.
68th N. I.	409	Deaths 3	—	—	—	1
47th N. I.	760	„ 2	11	13	9	8

TABLE No. IV.

Table shewing the Strength, number of Admissions, Deaths, and Causes of Death, in 3 Corps of N. I., from 1839 to 1844.

Years.	Corps N. I.	Strength.	Admissions.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	Causes of death.
1839	65	775	1610	Deaths 6	4	2	2	4	11	7	—	6	7	2	4	55	31 fever, 2 dysentery, 4 diarrhœa, 7 other diseases.
1840	65	609	842	„ 4	—	1	2	—	1	3	5	2	2	2	1	23	9 fever, 3 dysentery, 2 diarrhœa, 4 cholera, 5 other diseases.
1841	68	489	402	„ —	1	1	1	—	—	1	—	—	—	—	—	4	2 dysentery, 1 diarrhœa, 1 other disease.
1842	68	409	627	„ 3	—	—	—	1	—	2	—	1	—	—	—	7	6 fever, 1 other disease.
1843	66	522	1377	„ 2	7	3	3	9	3	1	2	2	2	1	1	36	15 fever, 3 dysentery 10 diarrhœa, 8 other diseases.
1844	66	532	1699	„ 1	—	2	1	—	1	1	—	—	1	3	1	11	6 fever, 1 dysentery, 4 other diseases.

TABLE No. V.

Table shewing the Strength and number of Deaths for a series of thirteen years in seven Corps of N. I.

Years.	N. I. Corps.	Strength.	Deaths.	
1831	66	460	19	Superintending Surgeon's Returns.
1832	66	620	17	
1833	25	600	37	
1835	40	680	55	Regimental Returns.
1836	40	633	33	Superintending Surgeon's Returns.
1837	67	749 ?	66	
1838	67	687	3	
1839	65	775	55	
1840	65	609	23	
1841	68	489	4	
1842	68	409	7	
1843	66	522	36	
1844	66	532	11	

Deaths 4.3 per cent.

TABLE No. VI.

Table shewing the proportion of Deaths in different months of the year.

Years.	N. I. Corps.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1833	25	Deaths 1	—	2	5	1	12	7	6	4	2	3	2	Regimental Returns.
1835	40	„ 7	6	7	5	6	3	11	2	3	1	2	2	
1836	40	„ 2	3	2	2	3	4	8	11	1	1	3	—	
1839	65	„ 6	4	2	2	4	11	7	—	6	7	2	4	Superintending. Surgeon's Returns
1840	65	„ 4	—	1	2	—	1	3	5	2	2	2	1	
1841	68	„ —	1	1	1	—	—	1	—	—	—	—	—	
1842	68	„ 3	—	—	—	1	—	2	—	1	—	—	—	
1843	66	„ 2	7	3	3	9	3	1	2	2	2	1	1	
1844	66	„ 1	—	2	1	—	1	1	—	—	1	3	1	
Total,		26	21	20	21	24	35	41	26	19	16	16	11	
Total,	—	1st period 88				2d ditto 126				3d ditto 62				

From the foregoing Tables, which like the preceding remarks, are necessarily very imperfect—a few deductions of some interest may be drawn. But it is proper to remark in the first place, that the Superintending Surgeon's returns indicate the number of deaths in hospital only, while the deaths of those who die away from head-quarters or on out-post duty, are recorded in the regimental returns.

1. From Tables I. and VI. it is plain, that among both Native troops and Mughs, the four months of the year during which most rain falls, that is May, June, July and August, are the most unhealthy.

2. From Table II. of three corps, all under the influence of a very moist climate, it appears, that the local battalion is more unhealthy even than the Assam light infantry, that its mortality is far greater than that of local corps or of native regiments in the Upper Provinces, among whom, under ordinary circumstances, 1.5 per cent. per annum is about the average. The Table also shews the remarkable healthiness of the Sylhet light infantry.

3. Table III. illustrates the short account given above of the 47th and 68th N. I.

4. Table IV. shews fever and its sequelæ in Natives (dysentery and diarrhœa,) to be the ordinary causes of death; it also shews how much the character of fever varies according to the *constitution* of the year.

Thus in 1839, there were among 1610 admissions 55 deaths.
And in 1844, ,, ,, ,, 1699 ,, 11 ,, only.

5. Table No. V. shews that the deaths at Khyouk Phyoo have never nearly equalled in number those at Barrackpore in unhealthy seasons.

Thus the 3rd N. I.	lost at Barrackpore in	1840	144
57th N. I.	.. ..	,,	150
58th N. I.	.. ..	,,	129

And in the year 1839,—42, 78, and 60 respectively, whereas the highest mortality at Khyouk Phyoo never exceeded 66; and the 67th N. I. for one year and the 68th N. I. for two, enjoyed better health than at the average of healthy Up-country stations. It also shews that the mortality among sepoys exceeds only in a trifling degree that of the Mughs who are natives of the country.

As the general result of these remarks, we would say, that the climate of Khyouk Phyoo has not proved so fatal to our sepoys, as has been commonly supposed: and that now, when the station is open and the lines are excellent, we see no obvious reason why a regiment should suffer much, if it be sent down direct from the Upper Provinces, if the voyage down be made quickly, and it arrives towards the end or at the beginning of the year, especially if the corps does not contain a large proportion of young men.

As to Akyab, it has many disadvantages of situation, and although much may be done to improve it, it is not probable that it will ever be so healthy a station as Khyouk Phyoo.

The experience of recent years has shewn, that there is nothing very inimical to the health of European Officers in the climate of Khyouk Phyoo, and the mortality in former years was mainly owing to the want of good houses, to unnecessary exposure to the sun, and to the irregular habits of life which used to prevail, at Akyab more especially.

Remarks on Parasites.

[In our last volume, our readers were presented with pretty copious expositions of two of the most popular modern theories of disease, both possessed of much ingenuity, and one of them very generally though over-hastily adopted. Indeed as to the chemical theory, Liebig himself now doubts the very existence of *protein*, the oxidation of which formed the corner stone of his whole system. And as to the natural historical one, which has never been so popular, it seems not improbable, that the animal and vegetable parasites which, according to it, were the supposed exciting causes of disease, are only to be found in the altered secretions, that is, in the products of disease. The following remarks of Henle on parasites possess a good deal of interest from bearing on the question of equivocal generation. They form a supplement to his paper in the last volume.]—J. M. P.

The present age is not in general inclined to adopt the doctrine of equivocal generation, partly owing to the more accurate modes of research now in use, and partly owing to the important discoveries which have been made as to the structure of the lower organizations, which used to be set down as products of equivocal generation. The following points are opposed to the spontaneous development of the *Entozoa*, and render their propagation by means of ova more intelligible.

1. The extraordinary degree of development of the generative apparatus, and the immense fertility of most *entozoa*. Thus a female round worm is believed to contain about 60,000,000 eggs, and the tape worm besides forming hundred of eggs in each of its numerous joints, throws off from its head whole rows of joints, and reproduces them. The like is the case with the *Bothriocephalus latus* and *Punctatus*.

This extraordinary power of reproduction would be quite as superfluous in them, if spontaneous generation were possible, as it appears to be necessary, if they are to be continued by sexual reproduction, in situations where they are exposed to so many injurious influences.

2. The *entozoa* during their development, assume various forms differing much from each other, some one of which seems to be suited for their living out of the body, or at least to facilitate their passage, from one body to another.

3. The *entozoa* wander through the body which they inhabit, as well as through its surrounding media. Their easiest and shortest way to reach the internal organs, is through the skin or perhaps also through the blood vessels, at all events there is no doubt as to the fact that they can live in the blood.

4. Most of the intestinal *entozoa* are very tenacious of life, and after being dried, can be again awakened to life by the application of moisture.

5. The occurrence of certain intestinal worms only within certain defined districts, is an indication of their having a definite distribution. Instances of this are, the occurrence of *Bothriocephalus latus* and *Tænia Solium*—in individuals who have resided for a time in localities where they are endemic, or the production of dry rot in sheep by pasturing them on marshy ground, &c.

It is no doubt true that there is a class of internal parasites, which until lately could not be shewn to multiply themselves in the same way as those already alluded to; namely, *hydatids*, and in which neither generative organs nor ova had been recognised, and it is on them chiefly that the supporters of equivocal generation rely. But the recent researches of Klencke seem to place it beyond doubt that hydatids multiply by ova, like other animals.

Dr. Rink, *(Geologist attached to the Danish Expedition,) on the Geological Structure of the Nicobars, in a letter to Dr.* M'Clelland.

My dear Sir,—Leaving Calcutta, I expected to follow the Corvet "Galathea" on her circumnavigation; but several circumstances induced me to alter my plan, and to remain here at the temporary Danish establishment at the Nicobar Islands, and thus, at all events, await the resolution of our government as to their retaining the possession of the Islands or not. What especially induced me to this, was that they contain a large field for every branch of natural science and investigation, more particularly so in my department, where they offered many points which seemed worthy of more accurate observation and reflection, than it was possible to bestow during a few excursions while the Corvet Galathea remained, particularly as the country is wild and impenetrable, and the season happened to be hot. But still I have so much hope, that it might be of some interest to you, that I avail myself of the opportunity offered me by Captain Lewis, who leaves this harbour for India, to send you some general observations concerning the constitution of these Islands, being so closely connected with those countries, whose Geology occupies your attention and owes so very much to you.

The hills of the northern group, Nicobar Islands, are surrounded by a low belt of coral formation, particularly the Islands Teressa, Bampuka, Tillangschong, Nangkoory, Kamorta, Trinket. Those I have had opportunity of visiting, form a system quite different from the southern group. These Islands are all for the greatest part of Plutonic origin. The rocks belong to those, which at remote periods have broken through, and disrupted granite, particularly serpentinic. All the places presenting a section of the soil, shewed compact varieties of serpentine or serpentinic gabro; but many pebbles found on the coasts and in the beds of the rivulets present specimens of a more crystalline aspect, containing the ingredients separated from each other; and according to this there is no doubt, that different kinds of sienitic, augitic, and dioritic porphyry alternate with the principal serpentinic rocks. The small Islands, Bampuka and Tillangschong, consist of these merely Plutonic rocks, rising out of

the sea, and only covered with the soil formed by the decomposing effects of the atmosphere, and supporting a more or less vigorous primitive vegetation. But on Kamorta, Nangkoory and Trinket, which are not so high in comparison to their size as those above mentioned, the ground is rather undulating, and forming a range of less significant hills and valleys; the Plutonic rocks certainly appear on different points of the Islands, but those parts which are lying between these points are covered with beds of Neptunic origin. These beds consist chiefly of a singular soft claystone of a grey, and sometimes of a white colour; when examined with the microscope, it seems to have a very uniform composition, containing only some white, sometimes pipe-formed spots, and no mica at all. It resists the action of strong acids, and when dissolved by melting with carbonate of soda, it exhibits some oxide of iron, magnesia, and alumine, joined with a large quantity of silex. The claystone itself is very light and spongy, absorbing water and adhering to the tongue: nearly all the hills formed by it appear naked, and covered only with low grass instead of tree jungle; and this seems to prove, that they are not fertile nor fit for cultivation, which also was to be expected from a soil containing no mica, and no sand to make it loose and porous and render it accessible for the chemical action of the atmosphere. The claystone is not schistous at all, but contains in several spots many clefts filled with fine crystals of gypsum and thin plates of red ironstone, both formed by the action between carbonate of lime and a solution of sulphate of iron from oxydated pyrites. This gypsum is again acted on by the magnesian earth of the clay, which forms an efflorescence of sulphate of magnesia on several cliffs exposed to the open air. The lower parts of this claystone are always traversed by a conglomerate or conglomerous sandstone, composed of fragments of the above mentioned Plutonic rocks, which appear on different points of the Island; and at some places, principally most near the Plutonic hills, the conglomerate is by far the prevalent. These places are also generally covered with the most impenetrable jungle, and seem to contain a much more fertile soil. The composition of the clay as well as that of the conglomerate seems to prove, that both are formed during the progress of the ascent of the Plutonic rocks out of the sea. The

higher points of these having appeared first above the level of the sea, and being exposed to the chemical action of the atmosphere, and the mechanical action of the surf, have principally given the materials for the beds of claystone and conglomerate, of which the first is deposited in almost still water and the other in stronger currents.

The following section, (Fig. 1, Plate IV,) may be sufficient to give you an idea of the geological constitution of Kamorta.

The spots marked [* * *,] show the underlying Plutonic rocks, [/ / / /] the beds of clay, [. . . .] sandstone and conglomerate, [- - -] the recent coral formation. This section may also show, that there is no constant line of strike, and no regular stratification at all. Passing from these Islands down to the southern group, or the Great and Little Nicobars, with the smaller Islands adjoining, we meet with a quite different formation; here we find a very extensive system of alternating sandstone and slaty claystone or marl, deposited on the bottom of the sea in large beds, and quite independent in their origin from the Plutonic rocks above mentioned. The sandstone is very soft; but we find imbedded in it another sandstone much harder and forming large balls, disposed generally in ridges, like flint nodules in chalk; the connecting matter of both kinds is carbonate of lime. Kept some time in muriatic acid, they are converted into sand, composed of grains of quartz and mica, which have the same size, and the same aspect, both in the hard and the soft stone. Indeed they only differ in their composition by the quantity of lime contained. The claystone likewise contains much lime and is very hard. These beds are lifted up in a regular manner according to the line of strike from SSE. to NNW., which is found almost the same every where from the north point of the Little Nicobar, to the south point of the Great, and I suppose this is also the case on the Island of Kathshall. It is easy to see that this is the direction of the volcanic belt from Sumatra to the Andaman Islands; the falling of the strata I have found on the Little Nicobars to be nearly from the middle of the Island to both sides, and independent of the inequalities of the surface, the inclination is generally very great, and almost perpendicular near the line of elevation. The height of the mountains formed by these rocks is not inconsiderable. On the Great Nicobars, they reach 2,500 feet, they are covered with a loose soil containing all

the ingredients necessary for fertility, as clay, sand, mica, and carbonate of lime. Hence there is not one single spot uncovered with high tree jungle. But there is no doubt, that with the exception of some steep parts of the mountains, the Islands would be very well adapted for the cultivation of those plants to which the climate is suited.

On the coasts of the southern Islands pieces of pit-coal are very often found; I frequently picked up some myself, and the natives when on fishing excursions, found it in the most diversified places, and brought me many specimens, they were all rolled and seemed to have been exposed to the action of the waves for a long time. Some of them had the appearance of very good coals; and I suppose, those brought to you by Capt. Lewis, from the Islands, have been of this description; but many of them had evidently the fibrous texture of wood, and when burnt, they produced a strong smell of pyroligneous acid. The great interest attached to the question of good coals on the Islands, induced me principally on this account to examine the rocks of sandstone and clayslate; and at last I found several traces of it, both in the sandstone and in the clayslate. These traces consisted in thin streaks of coal in the rocks, sometimes exceeding the thickness of one inch, but of no considerable extent, and in nodule formed pieces, imbedded in the soft sandstone. But the principal indications for good coals, as shales and impressions of cryptogamous plants, were entirely wanting, though the high inclination of the strata, and the many steep cliffs, gave sections of a long series of beds of different periods. I am therefore induced to believe, that the coals are belonging to a more recent period. Whether there are some large beds of this mineral or only those detached parts here and there derived from drift wood, can only be decided when the Islands are somewhat cleared and fit for being more minutely examined. As, from the generally high inclination, nearly every bed of the strata must somewhere reach the surface, much might therefore be expected from a regular Geological Survey; it would of course be out of the question to make boring experiments before examining in the way proposed.

I now at length come to some remarks on the recent geological history of the Islands, I mean their increasing by corals and by the gradual rising of the land by subterranean forces. All these Islands,

whatever their geological structure may be, are more or less surrounded by a very vigorous growth of corals. These animals, being attached with their fabrics to a certain place, and not able to move or to go in search of their food, are particularly fond of those places, where this want is redressed by the motion of the water near them; and we accordingly find the growth of coral most vigorous in those places where the water of the sea is most exposed either to surf or to periodical currents. The following sketch (Fig. 2, Plate IV,) is meant to show a very common section of these reefs, belonging to what are termed by Darwin, fringing reefs, with the annexed coast land:

m. The older formation of the Island.
n. Limestone.
o. Coral.

D C is high water line, and E B the low water line. From A to B are the living corals, and here the surf is heaviest. The plain from B to C, nearly dry at low water, is formed by a conglomerate of fragments of corals, shells, and pieces of the surrounding rocks, C J represents a small bank formed by the surf at high tides, (aided by the action of the wind upon the dry coral sand) heaping up fragments of corals, and from F to G the soil is found to be composed of fragments of corals and gravel intermixed with vegetable matter; this part is no longer overflowed by the waves, but entirely incorporated with the Island; it is covered with a rich vegetation, and affords the natives nearly all their supplies for shelter and food, supporting their huts and nourishing their cocoa-nut trees. Suppose the living corals at A B should take to building farther out, the bank at C F and the jungle are likely to follow in the same direction, and the land will increase according to the general geological laws. But if this action is further conjoined with a general rising of the land by subterranean forces, the augmentation of the land will go on in a greater degree. It is very curious to see from the distribution of this coral-land how different the outlines of some islands have been, even at a comparatively recent period, from their present form; to see how different parts of larger islands have by themselves before formed smaller islands, and how smaller islands are in rapid progress to be incorporated in larger ones. I often penetrated from the shore

through the jungle into the interior of the islands by the help of rivulets, which, as annual streams, hollow out the ground to the depth of twelve feet, and leave their beds dry when the periodical rains have subsided. Here I found the conglomerate of large pieces of corals at the height of more than twenty feet above the highest stand of the sea; but still I did not consider this as sufficient to prove the rising of the land, until I found the most doubtless traces of the same thing on the coast of the Island Bampuka. On the south-west side of this, there is a steep cliff of coral limestone, A B, (Fig. 3, Pl. IV,) close to the sea, raised to the height of forty to fifty feet, and resting on the Plutonic rock, fragments of which are contained in the lower parts of the calcareous rock. The coral formation here took its rise when the water touched the point C, and proceeded outward during the rising of the land, until it met with some hindrance near B, probably a sudden steepness of the Plutonic rock, giving no support to the building of the corals. This fact might be of some importance as a confirmation of the theory of Darwin, who considers the fringing reefs as characteristic of those tracts of land which contain active volcanoes, (as Barren island,) and which are in a state of progressive elevation.

These few remarks, My dear Sir, I hope will give you some idea of what I have seen on the Nicobar Islands, the geological study of which, afforded me occupation as well as amusement during my stay on this wild and solitary place. In case Capt. Lewis should go directly to Calcutta, I will send with him a small case with specimens of the rocks surrounding this harbour. A more complete collection of all those kinds of rocks which constitute the Nicobar Islands, I am arranging for you at the Little Nicobars, where I have established my museum and chemical laboratory in a hut. This I will have the honour of sending you from Penang, together with a more circumstantial description. But still I should be very glad, if you would honour some of the above observations with a corner in your Journal; and lastly, I desire you not to forget that this letter is written by a foreigner, who hitherto had only very little opportunity of practising English correspondence. I remain, &c.

Nangkoory Harbour, 13*th May*, 1846. H. Rink.

Specimens received from Dr. Rink, *with the above interesting letter.*

Conglomerate covering the Plutonic rocks at Nangkoory.
Claystone, with some of the sandstone alternating with it, at Kamorta.
Claystone very common on the Island of Kamorta, with some sulphate of magnesia.
Conglomerate sandstone of Kamorta.
Sulphate of magnesia found in the claystone of Kamorta.
Plutonic rocks near the village Unjadug, Nangkoory.
Claystone from the flagstaff hill at the Nangkoory harbour.
Sandstone alternating with the claystone at Kamorta.
Plutonic rock near the village of Alhacoong, Nangkoory.
Claystone very common on the Island of Kamorta, taken from the flagstaff hill at the Nangkoory harbour.
Conglomerate sandstone, Kamorta.
Claystone near the village of Unjadug, Nangkoory.
Small Dyke in the Plutonic rocks at Nangkoory.
Sulphate of lime found in the claystone at Kamorta.
Conglomerate alternating with the claystone at Kamorta.

Correspondence with Major Jenkins, *on the discovery of Coal of a very superior description, in a new situation in Upper Assam. By Lieut.* Dalton, (Plate V.)

[Private Letter from Major Jenkins to Dr. M'Clelland.]

I have great pleasure in sending you herewith a few specimens of coal which have just been sent me by Lieut. Dalton. They are from an entirely new locality under the Abor hills, a little above Dibrooghur, or about the point where the hills approach nearest to the river: the exact spot is unknown to me. The veins were found in a small Nullah called the Durjmoo, just a little within the gorge of the hills.

We are indebted for this discovery to Lieut. Dalton and Captain Reid, who have been lately making a small excursion up the Durjmoo, the first ever made by an European.

The only point of geology that Dalton notices as connected with this coal, is the following:—

"We entered the gorge of the hills through which the river (Durjmoo) emerges to the plains, and found ourselves, by a sudden transition in a very deep ravine, locked in by most precipitous hills

with bases of bare rock, of a dark red sandstone, in which were veins of the coal, some specimens of which I send you. Having no implements of any kind with me, I could only break off pieces exposed to the atmosphere. I suppose therefore much better specimens could have been procured by a little mining."

The Durjmoo is probably the first stream that falls into the Berhampootur, west of the Dihong. I have asked Dalton to give me a little sketch of the place, and any further particulars he can recollect. I will also try and get a boat sent up for further specimens.

In going up the nullah, Dalton and Reid passed through some scattered hamlets of Abors, who make a precarious living by selling rough hewn oars to the Dooms.

From Major F. JENKINS, *Commissioner of Assam, to* J. M'CLELLAND, *Secretary Coal Committee. Dated Gowhatty, 28th July,* 1846.

I have the honour to forward a copy of a letter from Lieut. Dalton, of the 18th instant, reporting the discovery of some veins of coal under the Abor hills, at a point nearly due north from Dibrooghur, by himself and Captain Reid, of the Artillery Regiment. A copy of a sketch map by Lieutenant Dalton accompanies—and I beg to mention having sent some samples of the coal to your address by dawk banghy.

2nd. I shall be obliged by an opinion on the quality of the coal as early as convenient.* The locality seems most convenient, and should the coal appear of sufficient value, I would endeavour to have further researches made as to the number, and extent of the beds, early in the cold weather.

From Lieutenant E. T. DALTON, *Junior Assistant to the Agent Governor General, to Major* F. JENKINS; *Debrooghur, the 18th July,* 1846.

The specimens of coal I had the honour of sending for your inspection some days ago, were found by me on the banks of a small river called Durjmoo, to shew the position and course of which, and the place where the coal was found, with relation to Debrooghur and the

* It is pitch coal, of a very superior description.—J. M.

Brumahpooter, I have the honour to annex a rough sketch map. (See Pl. IV. Fig 3.)

2nd. Last month Captain Reid, Commanding Assam Local Artillery and myself heard of this river, and went in search of it, as it had not been previously explored, and was only known by name as one of the auriferous streams of Luckimpore. Rising in the northern Abor hills, and falling into the most western of the great Sootis, of the Brumahpooter, it flows through that unfrequented portion of the valley of Assam extending from the Dehing river to the Seesee villages.

3rd. As it is nearly dry in the cold season its hill course must be a very short one, it emerges on the plains of Assam from a deep ravine, between high cliffs of crumbling and very porous sandstone, interlying which, we observed the veins of coal in layers, as near as I could guess of from three to eight inches in thickness, with a very gentle dip and inclination as if the direction of the veins was from under the Brumahpooter.

4th. Having no iron instruments of any description with us at the time, and being anxious to return to our camp as speedily as possible in consequence of the intense heat of this confined valley, and the increasing force of the mountain torrent we were endeavouring to stem, I was unable either to observe much, or to secure more favourable specimens; those sent being broken from the thinnest veins, where a fracture in the overlying rocks had laid bare a portion of the coal and rendered it easy of removal.

5th. From the number of parallel layers seen in one spot however, it is probable that a more extended search would bring to light larger and finer veins. Such a search would best be prosecuted in the cold season, when the hill course of this stream might be explored to some extent on foot, it being used as a route of communication with the plains by some of the Abor tribes.

6th. On my return to Debrooghur, I sent the men, who had gone with us, back with pickaxes, hoping they would be able to bring a boat-load of the coal, but the river was so flooded when they got to the foot of the hills that they were unable to take up the boat, and returned with only a small basket full of broken fragments.

Until the quality of the samples sent has been tested, and it is ascertained that there is a bed sufficiently productive to be worked with profit, it is hardly worth while reporting at any great length on the product, but I may add, if it answers expectations on the above points, that the situation is most favourable in being so near the Brumahpooter, at a point (Dibroo Mookh,) where it would be peculiarly advantageous to have a coal depot in the event of steam navigation being introduced.

7th. We received intelligence of three other small rivers flowing from the northern hills into the Boori Sooti of the Brumahpooter between the Dirjmoo and the Dihong rivers, and we saw the mouth of another hill stream, called the Demoo, an affluent of the former: it is probable that an examination of the hill courses of all these streams will lead to the discovery of more veins of a similar coal.

I have picked up bits of it in the beds of the Soobunsheri and Soondrie rivers of the north bank, but though I have examined the hill courses of both these streams, I never came upon any veins or beds of coal.

8th. I am sending by to-day's dawk a box containing a few more samples, and a fragment of the rock with a bit of the coal attached to it.

Fifteenth Meeting of the British Association for the Advancement of Science.

FRIDAY, JUNE 20TH.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

'On the Influence of Friction on Thermo-Electric Phenomena,' by Prof. P. Erman.—This communication was made by his son, M. Adolphe Erman, who had been invited to the Magnetical Conference.

M. Paul Erman examined the influence which friction, at the point of contact of two heterogeneous metals, exercises on the needle of a Nobili multiplier, combined with the metals. He then briefly recapi-

tulated the history of this part of electrical science, and resumed by saying, that between the two extremes of electric omnipotence and of electric nullity, which have been attributed to the friction of conductors, he endeavoured to find out the mean course of truth. The first step he reached in this career by a great variety of experiments, (on different groups of metals, their primitive temperature being equal to that of the surrounding space, or lower or higher than it,) was, that the effect of such friction is always like that of an addition of heat to the point of contact. This was shown, among other methods, by the fact that groups of metals which, by difference of temperature, give rise to an electric current of an anomalous weakness or direction, act similarly when rubbed. This applies to galena, sulphuret of molybdena, and some others. In allusion to this intermediate office of heat, our author calls the dynamical electricity produced by the friction of conductors, the tribo-thermic electricity. But now the wonders and paradoxes which happen where things are in the *status nascendi* present themselves once more in this case; but when exerting its tribo-thermic effect, it is neither like conducted heat nor like radiant heat. Indeed, its production when friction commences, and its disappearance when friction ceases, prove entirely independent of the mass of the rubbing bodies; and almost independent, also, of the duration of the process which produces it. M. Erman points out, that these remarkable facts seem to be highly favourable to the supposition of a peculiar kind of molecular vibration, excited exclusively in the rubbed points, and spreading through the conducting medium as instantaneously as electricity does. Connected with this fact is a circumstance which M. Erman thinks will be used for the measurement of tribo-thermic effects, almost in the same way as the two fixed points of our thermometers are used for temperature; viz.—there exists, for any group of thermo-electric metals, a given positive and a given negative difference, between their temperature and that of the surrounding space, which, when previously existing at the point of contact, continued friction will have no further influence on the electric current. In another part of this valuable paper, M. Erman reports some facts connected with the brilliant discovery of Peltier, that, according to the direction in

which it travels, an electric current can as well cool as heat the point of contact of heterogeneous metals. He examined the effect of friction on bismuth and antimony in the four following cases:—

When heated.	When at the temperature. of surrounding space.	When cooled.
Antimony.	Bismuth.	
Bismuth.	Antimony.	
	Bismuth.	Antimony.
	Antimony.	Bismuth.

and he found, that the same act of friction produces in these different cases, and with regard to the different metals, at one time a gain of electricity accompanied by a gain of heat, at another time a loss of electricity with a gain of heat; again, either a loss or gain of electricity joined to a loss of heat; and asks, may it be hence inferred that heat when nascent has a property specifically different from that of heat residing in a metal? Are we perhaps on the eve of finding at length something analogous to the brilliant discovery of Peltier, that galvanic electricity produces heat when proceeding from antimony to bismuth; and cold when travelling in the opposite direction? by which M. Lenz has produced congelation. M. Erman's chief object in communicating this paper to the British Association was, to excite British philosophers to engage in this almost new branch of investigation of tribo-thermic electricity. At the same time, he excuses the imperfections of the investigations submitted, by the extreme difficulties of such delicate experiments. Among these, he particularized the almost unavoidable influence of heterogeneous rheophores, which must be joined to the metals under examination. This difficulty caused him wholly to reject the first set of his experiments, until at last he found that the interposition of a plate of pure plumbago between each metal and its conducting wire proves an excellent means for limiting the anomalous production of electricity, without lessening the conducting power of the system. In conclusion, M. Erman suggests an important practical application of this tribo-thermic electricity. Instead of the voltaic apparatus in an electric telegraph, which is variable in its effects and

expensive in its application, and may by use get deranged or incapable of action, perhaps at a moment when most required, he proposes to substitute this purely mechanical mode of exciting electricity, so as to effect a distant magnetic needle, and thus transmit signals. It is accomplished by simply removing a detent from a piece of clockwork, when a disk of bismuth rubbing against one of antimony excites the distant needle. He has tested the method for tolerably long distances.

A Report was read from the Committee appointed at York, consisting of the Rev. Dr. Robinson, Prof. Challis, and Lieut. W. S. Stratford, R.N. for the purpose of continuing the publication of the British Association Catalogue of Stars, with the sum of 615*l.* at their disposal:—

1. That the Catalogue is completed, and ready for publication. 2. That the MSS. &c. have been deposited at the Kew Observatory. 3. That the whole of the expenses incurred in the production of the Catalogue (500 copies) have been paid, and that no further grant will be needed. 4. That of the grant of 615*l.* there has been expended, agreeably to the accounts sent herewith—For press-work, 40*l.*; printing and paper, 511*l.* 15*s.*; binding MSS. 11*l.* 14*s.* 6*d.*; total, 563*l.* 9*s.* 6*d.*; leaving a balance of 51*l.* 10*s.* 6*d.* 5. That the entire cost of the Catalogue has been—For books, 4*l.*; skeleton forms, 64*l.*; calculations, 537*l.* 16*s.* 6*d.*; printing and paper, 511*l.* 15*s.*; press-work, 75*l.*; binding MSS. 11*l.* 14*s.* 6*d*; total, 1,204*l.* 6*s.*, which is equivalent to nearly 2*l.* 8*s.* for each copy.

W. S. Stratford.

The Dean of Ely bore testimony to the importance of the printing of this Catalogue to the interests of science, and commented on the very small cost at which it had been achieved.

The Committee appointed at York, consisting of Sir J. Herschel, the Astronomer Royal, and Lieut. W. S. Stratford, R.N., to continue the reduction of the Stars in the Histoire Céleste of Lalande, and the Cœlum Australe Stelliferum of Lacaille, made the following Report:—

Hist. Cél. 1. That the whole of the Stars in the Histoire Céleste have been reduced. 2. That the press-work has proceeded as far

as sheet 2 T, ending with No. 26,240 of the Catalogue. 3. That the whole will be ready for publication before the next meeting of the Association.

Lacaille.—4. That the whole of Lacaille's Stars have been reduced. 5. That the Catalogue is printed, and there remains to be prepared the Preface and Notes, both of which have been delayed by the lamented decease of Prof. Henderson. 6. That this Catalogue will also be ready for publication before the meeting in 1846. 7. That the balance of the Government grant of 1,000*l.* for printing these Catalogues was, at the previous meeting, 934*l.* 2*s.*, out of which there has been paid to the printer, on account, 300*l.*; leaving a balance of 634*l.* 2*s.*, the whole of which will be required before the next meeting. 8. That the appointment of a committee to continue the printing of these works is necessary.

W. S. Stratford.

'On a new Anenometer, by Mr. Goddard;' [see a letter from Mr. Goddard, *Ath.* No. 882.]

'Meteorological Observations made at Huggate, Wold, Yorkshire,' by the Rev. T. Rankin. Mr. Rankin exhibited tables. The chief results were:—

The elevation was about 700 feet above the level of the sea. The greatest monthly range of the barometer was	0·850
Greatest daily range	0·290
The highest barometer, February 24th	29·950
The lowest, May 15th	28·240
The highest thermometer, July 25th	74°
The lowest, February 23rd	20°
Greatest monthly range of thermometer (May)	34°
Greatest daily range, May 9th	29°

The deficiency of rain for the year was 10 inches. In the month of December, Millington Springs, in the adjoining parish, and which flow from the top of a bed of clay lying below a chalk rock, above 200 feet thick, were as low as in the summer of 1826.

Rev. T. Rankin's additional Thermometrical Observations in a deep well at Huggate. The well is 348 feet in depth :—

December 9th, 1844,	top of well	38	degrees, at 4 P. M.
"	150 feet deep	42	"
"	300 feet deep	45	"
"	water at bottom . . .	43	"
March 11th, 1845, . .	top of well	32	degrees, at 6 P. M.
"	150 feet down. . . .	38	"
"	300 feet down . . .	44	"
"	water	43	"
April 5th, 1845, . . .	top of well	50	degrees, at $2\frac{1}{2}$ P. M.
"	100 feet deep	45	"
"	200 feet deep	45	"
"	300 feet deep	43	"
"	water	42	"
April 23rd, 1845, . .	top of well	59	degrees, at 2 P. M.
"	100 feet deep	55	"
"	200 feet deep	50	"
"	300 feet deep	47	"
"	water	45	"
June 3rd, 1845, . . .	top of well	70	degrees, at 1 P. M.
"	100 feet down . . .	65	"
"	150 feet down . . .	60	"
"	200 feet down . . .	55	"
"	300 feet down . . .	52	"
"	water	46	"

The average of these five was—of the shaft . . . . 47·08
" " of the water . . . . 43·8

'On the Baron de Bode's Insulated Compass,' by J. Y. Oliver.—The object was to insulate the compass from the action of the iron of the ship. The contrivance was this: a double glass bowl, the intermediate space being filled with mercury, was made to act as the bowl of the ordinary compass. It was hung in gymbals, and protected with lead. This rendered it very heavy and cumbrous.

Mr. Dent objected, that if this insulation would protect the needle from the action of the ship's iron, it would also shield it from the directive force of the earth, and therefore render it useless: but upon placing a poker near the compass, it was distinctly affected through the insulating mercury.

SATURDAY.

'On some Points in the Meteorology of Bombay,' by Col. Sabine.—It would be impossible, within reasonable space, to give an intelligible abstract of this communication, it being itself a statement of conclusions derived from multitudinous observations. This, however, is to be the less regretted, as the communication is to be printed in the next volume of the Reports. The following are a few particulars, selected as a sample:—In a communication to Section A. at York, it had been shown, by a comparison of the two-hourly observations at Toronto, that when the gaseous and vapour pressures had been distinguished in the total barometer pressure, their annual and diurnal variations exhibited a striking and instructive accordance with the annual and diurnal variations of the temperature. And when these were projected in curves the characteristic features were seen to be the same, consisting in each case of a single progression, having one ascending and one descending branch. The epochs of maxima and minima, and other circumstances, having so close a correspondence as to manifest an intimate connection. The conclusions deduced from the facts at the York meeting, being compared with the results derived from the observations of M. Kreil at Prague, showed that the characteristic features of the periodical variations at Toronto were not peculiar to that locality, but might rather be considered as belonging to a station in the temperate zone, and in the midst of a continent. Soon after the York meeting, the publication of the Greenwich Magnetical and Meteorological Observations for 1842 enabled Colonel Sabine to add a postscript to the printed account of this comparison; showing the correspondence of the results at Greenwich with the periodical march of the phenomena at Prague and Toronto. From these premises it was inferred, that the normal state of the diurnal varieties of the pressures of air and vapour, and of the force of the wind in the temperate zone, might be that of a single progression, with one maximum and one minimum, the epochs of which should nearly coincide with those of the maximum and minimum of temperature. But a more complex state of the phenomena was to be looked for in particular localities, particularly where a juxta-position should exist of columns of air resting on surfaces

differently affected by heat (as those of sea and land), and possessing different retaining and radiating properties. Within the tropics, the well-known regular recurrence of land and sea breezes for many months made it obvious, that a *double* progression in the diurnal variations of the force of the wind must exist,—and rendered it probable that a double progression of the gaseous pressure would also be found. It was, therefore, with pleasure that he received from Dr. Buist a copy of the monthly abstracts of the two-hourly meteorological observations made at the observatory at Bombay, accompanied by a copy of his Meteorological Report for that year, giving a full account of the periodical variations of the wind; and in the explanations thereby afforded of the diurnal variations of the gaseous pressure at Bombay—which, although at first sight more complex than at the stations of Toronto, Prague or Greenwich, Colonel Sabine conceives to be equally traceable to variations of the temperature. The Observatory at Bombay is situated in the Island of Colabah, in north latitude 18° 54′, and east longitude 72° 50′, at an elevation of 35 feet above the level of the sea. Col. Sabine then described the tables as received, and the reductions to which he subjected them. The sun at Bombay is vertical twice in the year, viz. in the middle of May and towards the end of July. The rainy season sets in about the commencement of June (in 1843 on the 2nd of June,) and terminates in August; but with heavy showers, of no long duration, continuing into September. During the rainy season, and in the month of May, which commonly precedes it, the sky is mostly covered with clouds, by which the heating of the earth by day and its cooling at night by radiation are impeded, and the range of the diurnal variation of the temperature lessened; and the strength of the land and sea breezes in those months is also comparatively feeble,—sometimes almost without alternation. For these reasons he has, besides the tables, collected into one view the means of the months of May, June, July and August, or the cloudy months, in order to contrast them with the months of November, December, January and February, when the sky is for the most part clear. These reductions being made, the diurnal variation of temperature is found to have a single progression, being a minimum at 18 hours (6 o'clock, A.M.,) and a maximum at 2 hours; the average difference

being 7° ·77 in the clear season, and 3° ·71 in the cloudy; the mean of the year being 5° ·7. The tension of the vapour also exhibits the general character of a single progression, increasing from a minimum at the coldest hour to a maximum about the warmest: with a slight irregularity at noon, requiring future confirmation. In the gaseous pressure, however, we find a double progression distinctly marked; one maximum occurring at 10 hours and another at 22 hours: one minimum at 4 hours another at 16 hours; and this double progression is found both in the cloudy and in the clear season, with only a slight difference in the hours of maxima and minima: the principal maximum in the cloudy season being at 20 hours instead of 22 hours, and the inferior minimum in the clear season being at 12 hours instead of 10 hours. The range of its diurnal variation, like that of the temperature, is more than twice as great in the clear as in the cloudy season. Col. Sabine then proceeded to describe the phenomena of the direction and force of the wind; and finds, from Dr. Buist's Report, that for 200 days in the year there is a regular alternation of land and sea breezes; and, therefore, there is a double progression of the daily variations of the force of the wind during these 200 days. The land breeze usually springs up about 10*h*. or between 10*h*. and 14*h*. blows strongest and freshest towards day-break, and gradually declines until about 22*h*. at which time it changes, after a lull of an hour or an hour and a half. The sea breeze then sets in—the ripple on the water indicating its commencement; being first observed close in shore, and only extending gradually out to sea. The sea breeze is freshest about 2*h*. and progressively declines in the evening hours. Col. Sabine then proceeded with an explanation of the facts: and showed their coincidence with the principles,—including, as a necessary element, the separation of the aqueous and gaseous pressures. He then showed, that in the annual variations, the leading features are closely analogous to those exhibited at Toronto, Prague and Greenwich,—viz. a correspondence of the maximum of vapour pressure and a minimum of gaseous pressure with the maximum of temperature, and of the minimum of vapour pressure and maximum of gaseous with the minimum of temperature; and a similar march of the three variations—but the epochs or turning-points not in every case identical,

yet having an obvious connection. He then gave a tabular view of the monthly means for 1843 of the temperature, vapour pressure, gaseous pressure, barometer and humidity; and pointed out in detail their peculiarities and dependencies; and concluded by submitting the importance of either admitting or rejecting the propriety of separating the two pressures which unite in forming the total barometric pressure. The remarkable fact recently brought to light by Sir James Ross, as one of the results of his voyage, that the mean height of the barometer is nearly an inch less in the latitude of 75° S. than in the tropics, presses the consideration of this point upon our notice; for it is either explained by the diminution of the vapour constituent in the higher latitudes, which diminution appears nearly to correspond to the decrease of barometric pressure observed by Sir James Ross,—or it is a fact (not hitherto attempted to be explained on any other hypothesis) of so startling a character as to call for immediate attention.

Col. Sykes said, that there was one point to which, in his opinion, Col. Sabine had not assigned due importance,—viz. the influence of the monsoons. The disturbed atmospheric state during these extended from 52 to 120 days in the year, and gave rise to great fluctuations of the barometer and thermometer.—Prof. Lloyd urged the importance of separating the gaseous pressure from the pressure exercised by the more fluctuating constituent of the atmosphere, and congratulated Colonel Sabine on the advance he had already made in tracing the parts of the entire phenomena due to each; this he exemplified by pointing out various points of difference between the meteorology and the climate of St. Helena and of Dublin.—Prof. Dove was of opinion that the separation of the gaseous pressure from that of the aqueous does not lead to such simple results as those which he obtained by calculating the observations made at other places. Hence the question might arise, whether this separation was generally applicable. He then showed, that the elasticity of vapour diffused in the atmosphere is so small in the interior of the continent of Asia, that the curve of the whole barometric pressure is of the same form as that found for Europe, when from the barometric pressure we subtract that of the aqueous vapour. By this means, the curves for all places assume the same form, showing a single maximum and a single minimum; and this as well with

reference to the daily as annual variation. This leads us to a more precise definition of continental and sea climate; the former is one in which the diminution of pressure caused by the expansion of air by heat is greater than the increase of pressure produced by the evaporation of water; the latter in which the contrary takes place. The separating line, being that in which the compensation is exact, passes between St. Petersburgh and Moscow. The true phenomena of a continental climate are not met with in America, because there in the summer months the quantity of vapour is so great as to produce an over-compensation.—Sir J. Herschel spoke of the fact stated by Sir James Ross of the low mean state of the barometer in the southern seas, and concurred in the opinion, that the special attention of meteorologists should be directed to it.

'On M. Kreil's Self-Registering Meteorological Instruments,' by Baron von Senftenberg.—The self-registering instruments of M. Kreil register at intervals of 5′ continually the state of the barometer, of the thermometer, and of the hygrometer. The instruments are placed at Prague and at Senftenberg, which is nearly due east of Prague, about 100 English miles distant. It is situated on the Adler, 1281 Paris feet above the level of the sea, in latitude 50° 8′ 8″, and longitude east of Greenwich 1*h*. 5′ 46″ ·98; situated on lias and mica slate, and near higher grounds of granite, gneiss and old red sandstone, and considerable forests. Prague is in a more level country, with the river Moldau flowing through it in a breadth of about 200 fathoms: it is only 524 feet above the level of the sea, without much wood-land in its neighbourhood; the surrounding hills being lias, sandstone, and argillaceous schist. The Baron then exhibited the dotted curves produced by the instruments, and the curves and mean curves and tables deduced from them; and showed their use, by comparing the curves of Senftenberg with those of Prague, in informing us at which the changes began to occur first; this was readily inferred from the coincidences of the curves after having arrived at maxima and minima;—and concluded by pointing out, as an exemplification of their utility, the curious relations at each place during some remarkable thunder-storms.

Sir J. Herschel next laid before the Section the Report of the Magnetical and Meteorological Committee. As this Report was printed and circulated among the members before the commencement

of the meeting, in order to facilitate the proceedings of the Magnetic Conference, Sir John did not think it necessary to occupy time by reading it at length; he, therefore, merely read the conclusion, which contained the request of the Committee that the necessary grant of money should be continued. One branch of the Report, however, had not been ready in time to be printed with the rest—viz.—

'On Atmospheric Waves,' by Mr. W. R. Birt.—The author divided his Report into three parts. In the first he noticed the regular rise of the barometer every month above 30 inches; and the apparent regularity of the flowing of the waves producing the maxima and minima. In the second, the recurrence of the symmetrical wave observed in November, 1842, in November, 1843, and in October and November, 1844. And in the third he gave the latest results of the examination of the systems of waves traversing Europe from the 6th to the 11th of November, 1842; being a continuation of the Report presented at the last meeting. The Astronomer Royal having shown, in the volume of Magnetical and Meteorological Observations made at the Observatory, Greenwich, during 1841 and 1842, that in every month the barometer rose above 30 inches, Mr. Birt found the same results upon comparing the observations made at Toronto with those at Greenwich; so that, on both sides of the Atlantic, the barometer rises above 30 inches every month: and a closer comparison appears to indicate that the rise occurs *twice* every month. The author exhibited the barometric altitudes at several epochs, tabulated so as to show the force of these deductions; and, by tinted and coloured diagrams, he exhibited the connection that existed between the force and direction of the wind and the transit of these waves. He also traced the consequences that should result in many varied respects on the supposition of such waves passing along, and showed that these were in strict harmony with the actually observed phenomena at Greenwich, Prague, Munich and Toronto: and, as the latest result of his researches on this new and curious branch of inquiry, he exhibited a tabular view of five waves—viz. two from Scilly to Longstone, one from South Bph to St. Catherine's Point, one from Glasgow to St. Catherine's and from Brussels to Geneva, and one from Dublin to Bardsay; in which he compares the epochs of transits of the anterior trough, the crest

and the posterior troughs of these waves and their amplitudes, as to the number of miles traversed and times of traversing, from which he deduces a velocity of transit varying from 25 to 31 miles per hour: and in concluding his Report Mr. Birt remarked, that it is characteristic of waves that different systems pass onwards without destroying one another; each wave of each system pursues its own path although crossed by others; and it can be followed in all its individuality. In this inquiry three systems of waves have been detected, or at least three barometric maxima; these maxima have been found to move across the area in three different directions, having on each side a diminution of pressure. The progress of each of these maxima appears to have been independent of the others: thus, at the opening of the observations, the line of greatest diminution of pressure on the English area was from Glasgow to St. Catherine's Point; at a later period, the observations indicated the direction of maxima at right angles to this line, and that a line cutting this line of maxima transversely passed through Geneva and Brussels, nearly parallel to the former; it was in this direction the wave was considered to have been moving. The barometric phenomena in this direction progressed slowly. While these movements were proceeding over the area, the barometric differences between Scilly and Longstone increased; the latter station exhibited a much less pressure than the former. At length, a decided line of maximum pressure is traced from Dublin to Geneva, after which the barometric affections at the stations at Scilly and Longstone are reversed, Scilly being the lowest and Longstone the highest. We have, therefore, a cause simultaneously operating on the barometer with that which produced the movement from Glasgow to St. Catherine's Point and from Brussels to Geneva, but distinct as the phenomena progressed in different directions. During the period that these two distinct, but contemporaneous causes are in operation, producing certain barometric phenomena in certain directions, and from the last of which we should expect at certain stations—Scilly and Longstone, for instance—a rising barometer, we actually find it *falling* rapidly, but not without exhibiting the same phenomena that characterize this fall as resulting from a wave. A decided line of maxima is observed; and in the same line, at a subsequent

period, we find a line of minima. We can, therefore, as previously remarked, trace each of these distinct sets of barometric phenomena in their own peculiar directions. It is, however, the reduction of the observations to the level of the sea that enables us to do this: the rise and fall at any one station, as exhibited by curves (times being used as abscissæ) give the combined effects of the three systems; and unless they are separated by taking the distances of the stations into account, we are perplexed with the apparent irregularity of the atmospheric changes.

Sir J. Herschel said it was a remarkable circumstance, that Mr. Birt had been able to trace so close a connection between phenomena which had been observed at such distant places, and with considerable intervals of time. The subject promised to lead to important results.

'On the Results of the Magnetic and Meteorological Observations at Sir Thomas Brisbane's Observatory, at Makerstown, in the year 1842,' by J. A. Broun.—The following are the points of chief importance in the paper. From a comparison of five months, in 1841, with the corresponding five months of 1842, the yearly movement of the north end of the declination magnet is about five minutes towards the east. The horizontal component of the earth's magnetic intensity increases, and the vertical component diminishes considerably in the year; the diminution of magnetic dip being about five minutes. A new method has been adopted in order to obtain the temperature corrections for the bifilar and balance magnet; it is described in the sixteenth volume of the Transactions of the Royal Society of Edinburgh. It was merely mentioned that very consistent results had been obtained by different methods of comparison of the usual observations for the positions and temperatures of the magnets. When the observations of the balance magnetometer are corrected by this method the diurnal range of the vertical intensity has been found, like that for the horizontal intensity and declination, to increase regularly from the winter months to the summer months. The annual period of the horizontal intensity as deduced from the corrected observations of the bifilar magnetometer for 1842, is striking; a minimum of intensity occurs before or about each equinox, and a maximum before or about each solstice. The observations at

Toronto in Canada, in 1842, when corrected by the same method, indicate *exactly* the same periods. The monthly means for Makerstown and Toronto were projected in curves, which were exhibited; the two curves were almost identical, the increase of horizontal intensity being greatest in the end of the year at Makerstown. The corrected observations of the balance magnetometers confirm in some sense the results from the bifilar, inasmuch as they also show the same annual periods of maxima and minima for the vertical intensity. As a severe test of the accuracy of the instruments and the methods adopted, the results for the magnetic dip deduced from the true force magnetometers were compared, both as to diurnal and yearly change of dip, with the results obtained from the inclinometer, and they were found to agree. From the meteorological observations it was found that the range of the monthly means of the pressure of dry air, was nearly the same as for the moist air. The mean of the three-monthly maxima and minima of temperature for each quarter of the year, was found to differ only by a fractional part of a degree from the mean of all the daily maxima and minima for the same period. The mean of the monthly maxima and minima of atmospheric pressure is less than the mean pressure for the whole year. This, it is conceived, has been found to hold always true, at least for places within the latitudes 50° and 60° north; the reverse probably takes place in lower latitudes—it does so at Pekin; in 1841, the means of the monthly maxima and minima being in almost every month above the mean pressure. The curve of the relative humidity of the atmosphere for the year, deduced from the observations of the psychrometer, was shown to agree completely in its inflexions with the curve of the mean quantity of clouds covering the sky, this quantity being merely estimated.

The Astronomer Royal said that he was not quite certain that he understood Mr. Broun's proposed method of eliminating the effect of temperature on the magnetic force; but if he did, then he must protest against it, since the power of the needle itself, as well as the magnetic force of the earth, were affected by the changes of temperature, the effects of which he had eliminated.—The Rev. Dr. Lloyd said, it was found that it was absolutely necessary to subject the magnet artificially to considerable differences of temperature, in

order to estimate the effect of temperature, otherwise the probable error was found to be much within the limits of the errors of observation.—Prof. Forbes dissented from these statements, and said that it was at his request Mr. Broun brought forward these results, which he considered to possess much value.

'On the Connection between Magnetic Variation; with certain peculiarities of the Earth's Structure,' by S. M. Saxby.—Mr. Saxby was of opinion, that it will be found on examining the direction of the various mountain ridges of the globe, that there is a remarkable *angular coincidence* between such line of direction and the *local curve of equal magnetic variation,* the one crossing the other at angles of from 65° to 70°. This observation applies not only to extensive ridges of high land, such as the Alps, Carpathians, Andes, &c., but also to *submerged* mountains, the tops of which form *chains of islands;* and it is remarkable that in the Eastern archipelago, where we find extensive ranges of islands at right angles to each other, the coincidence alluded to is apparent, and it may be asserted, that the known globe affords no instance in which a general line of mountain ridge deviates more than two or three degrees from the above named angular coincidence. It might be interesting to notice the position of mineral veins in mountainous districts in connection with the above remark. There is also reason to suspect that the tracks of hurricanes, typhoons, tornadoes, and excessive elementary disturbances, approximate to the curves of magnetic variation.

Prof. Forbes could not assent to the views proposed by Mr. Saxby, and said that the most ordinary acquaintance with the effects of mountain chains on the magnet would be sufficient to show their incorrectness.

'On the Strength of Stone Columns, by Mr. E. Hodgkinson.—The columns were of different heights, varying from 1 inch to 40 inches; they were square uniform prisms, the sides of the bases of which were 1 inch and 1¾ inch, and the crushing weight was applied in the direction of the strata. From the experiments on the two series of pillars it appears, that there is a falling off in strength in all columns from the shortest to the longest; but that the diminution is so small, when the height of the column is not greater than about 12

times the side of its square, that the strength may be considered as uniform, the mean being 10,000 lbs. per square inch, or upwards. From the experiments on the columns one inch square, it appears that when the height is 15 times the side of the square, the strength is slightly reduced; when the height is 24 times the base, the falling off is from 138 to 96 nearly; when it is 30 times the base, the strength is reduced from 138 to 75; and when it is 40 times the base, the strength is reduced to 52, or to little more than one-third. These numbers will be modified to some extent by the experiments in progress. In all columns shorter than 30 times the side of the square, fracture took place by one of the ends failing; showing the ends to be the weakest parts; and the increased weakness of the longer columns over that of the shorter ones seemed to arise from the former being deflected more than the latter, and therefore exposing a smaller part of the ends to the crushing force. The cause of failure is the tendency of rigid materials to form wedges with sharp ends, these wedges splitting the body up in a manner which is always pretty nearly the same; some attempts to explain this matter theoretically were made by Coulomb. As long columns always give way first at the ends—showing that part to be the weakest—we might economize the material by making the areas of the ends larger than that of the middle, increasing the strength from the middle both ways towards the ends. If the area of the ends be to the area in the middle as the strength of a short column is to that of a long one, we should have for a column whose height was 24 times the breadth, the area of the ends and middle as 13,766 to 9,595 nearly. This, however, would make the ends somewhat too strong; since the weakness of long columns arises from their flexure, and increasing the ends would diminish that flexure. Another mode of increasing the strength of the ends would be that of preventing flexure by increasing the dimensions of the middle. From the experiments it would appear that the Grecian columns, which seldom had their lengths more than about 10 times the diameter, were nearly of the form capable of bearing the greatest weight when their shafts were uniform; and that columns tapering from the bottom to the top were only capable of bearing weights due to the smallest part of their section, though the larger end might serve to prevent lateral thrusts. This last remark applies,

too, to the Egyptian columns, the strength of the column being only that of the smallest part of the section. From the two series of experiments, it appeared that the strength of a short column is nearly in proportion to the area of the section, though the strength of the larger one is somewhat less than in that proportion.

Prof. Challis inquired whether Mr. Hodgkinson had found the columns to give way chiefly in the direction of the cleavages of the stone? Mr. Hodgkinson replied that he had; and that hence the same size and shape of stone cut out of the same block, required very different forces to crush them across the grain from what they did with it.—Prof. Stevelly said, that it was one peculiarity of Mr. Hodgkinson's researches, that they opened up so many collateral objects of interest and wide fields of inquiry. It was easy to see that the present researches might become important to the geologist, by leading him to the source from which originated the splitting up of extended rocks into beds and strata, and the contortions of them; for example, to some volcanic matter forced up vertically in such a manner as to exercise a crushing force upon even distant masses.—Prof. Willis shewed, by examples deduced from various styles of architecture, that the ancients must have been practically in possession of similar principles; and from several examples which he gave, it would appear that columns of a shape suited to these principles were again coming into use.

'An Improvement in the Method of taking Positive Talbotypes (Calotypes),' by Sir D. Brewster.—In the method now in use the face of the negative Talbotype is placed directly upon the side of the paper which has been brushed over with a solution of nitrate, or ammonia-nitrate of silver, and which is to receive the positive picture. In strong sunlight the picture is thus taken very quickly; but there is a roughness in the shades, owing to the formation of black specks, which destroys the softness of the picture, and in portraits gives a disagreeable harshness to the human face. In order to remove this defect, the author first interposed thin plates of glass, with their surfaces sometimes ground and sometimes polished; but, though the divergency or diffusion of the light, passing through the *negative* picture, produced great softness in the *positive*, yet the outlines were too indistinct, though the Talbotypes looked very well, when placed at a distance.

He then tried the effect of interposing a sheet of writing paper, without the water-mark and of uniform texture. The result of this experiment fully answered his expectations. The diffusion of the light thus occasioned shaded off, as it were, all the sharp lines and points, and gave a high degree of softness to the picture. The effect was even improved by interposing *two* sheets of clean paper; and, with a very bright meridian sun, he found that *three* sheets may be used with advantage. A similar effect may be obtained, in a smaller degree, by placing the *back* of the negative upon the positive paper, so as to cause the light to traverse the thickness of the negative, and this may be combined with one or more sheets of clean paper. This, of course, will be appropriate only with portraits; and it has the advantage (sometimes required) of making the figure look another way. To those who see the experiments above described for the first time, the effect is almost magical; and when the negative is removed, we see only a blank sheet of white paper; and our surprise is very great when, upon lifting this sheet, we discover beneath it a perfect picture, which seems as it were to have passed through the opaque and impervious screen. Sir D. Brewster exhibited specimens of portraits produced in this manner, and also specimens produced by the transmission of light through two perfectly coincident negatives of different degrees of strength; together with specimens of positives, produced by placing the positive paper between two perfectly coincident negatives, and acted upon by light incident on both sides of the picture. Sir D. Brewster mentioned some unexpected theoritical results, which these experiments indicated, but which required further investigation.

Saturday.

Section B.—CHEMISTRY AND MINERALOGY.

'On a New Property of Gases,' by Prof. Graham.—After explaining the law which regulated the diffusion of gases through porous bodies, and stating the fact, that the lighter gases diffused themselves much more speedily than the more dense ones,—that their diffusion was equal to the square of their densities,—he proceeded to relate his experiments on the passage of gases into a vacuum. To this passage the term Effusion has been applied. The velocity of air being 1; the

velocity of oxygen was found to be ·9500 by experiment, and by calculation ·9487. Carbonic acid being much heavier than air, gave the number ·812. Carburetted hydrogen gave ·1322 as the velocity of its effusion. Hydrogen gave as the velocity of effusion 3·613 by experiment, which was very nearly the amount given by theory. The interference of friction, even of minute orifices, was then described, and shown to admit of easy correction. Some useful applications were mentioned; as in the manufacture of coal gas, where it is desirable to ascertain the quality, as well as the quantity of gas manufactured. As the gas will pass the orifice on its way to a vacuum the quicker the lighter it is, and the more slowly as it increases in density, and as the superior carburetted hydrogen is heaviest, it would be easy to construct an instrument to register this velocity, and thus mark at once the required quality and quantity of gas. It was also proposed that an instrument might be used in mines to detect the presence of light carburetted hydrogen (fire damp). The passage of gases under pressure through porous bodies was termed by Prof. Graham, Transpiration. The mode adopted in experiment was, to take a glass receiver, open at the top, which was closed with a plate of stucco. This was placed on an air-pump, the air exhausted by the pump, and the velocity with which the air passed through the stucco being marked by the mercurial gauge of the pump. The transpiration of atmospheric air was found to be greater than that of oxygen. Carbonic acid is found to be more transpirable than oxygen—or even, under low pressure, than atmospheric air. The transpiration of hydrogen is one-third more rapid than that of oxygen. The applicability of this process of experimenting to the explanation of exosmose and endosmose action in the passage of fluids through porous bodies was pointed out.

Mr. Bain made some observation to the effect, that Prof. Graham's researches went to explain many meteorological phenomena, but particularly the suspension in the atmosphere of masses of aqueous vapour, in the form of clouds.

'On Recent Experiments on the Gas Voltaic Battery,' by Prof. Grove.—No previous description of the Gas Battery having been given before the Association, Prof. Grove entered into an explanation of the action of hydrogen gas upon spongy platina, and gave a descrip-

tion of the first gas battery constructed with platina wire sealed into glass tubes in pairs,—hydrogen being put into one tube, and oxygen into the other. An arrangement of this kind being connected with a voltameter, it was found that exactly the same quantity of gases was eliminated in the tubes of that instrument as combined in the tubes of the battery. Experiments have been made with a view of ascertaining if other gases might be used in the battery, and it was discovered that a great variety of gases might be so used. Prof. Grove then pointed out how perfectly any eudiometric analyses might be carried on with the gas battery, provided some attention were paid to a few sources of error. A form of the instrument as hitherto constructed by Prof. Grove was described, for the purpose of avoiding the absorption of atmospheric air by the fluid in the cells of the battery. A more recent construction of the battery was next described, in which many of the imperfections of the former instruments were removed, and a combination of several pairs of gas tubes are connected in one compact body. Another advantage arising from this battery is the really constant condition of it; once charged it appears that the action will go on for years, requiring nothing more than occasionally, at long intervals, adding a little zinc to the acidulated solution in the cells, for the purpose of supplying the loss of hydrogen in the tubes. The results of long experiment have shown, that the most invariable action may be calculated on for years; and that, by this instrument, experiments requiring for a long period the constant flow of a galvanic current may be most effectually carried out. Some experiments on the combination of phosphorus and sulphur with oxygen in the battery were then named; and it was found, that any body capable of volatilization gave a galvanic action with oxygen in the other tube. Camphor, alcohol, ether, and other bodies proved the constancy of this effect. It was then stated, that in all cases it had been found that chemical action and voltaic action were convertible into each other.

'On the Action of Gases on the Prismatic Spectrum,' by Dr. Miller.—Referring, in the first instance, to the experiments of Sir D. Brewster, on the changes produced on the fixed lines of the prismatic spectrum by various absorptive media, Dr. Miller proceeded to explain his method of examining the subject. The light, being passed through a longitudinal slit in a plate of metal, was received

on a prism of Munich glass; the spectrum thus formed was passed through the gaseous medium under examination, and the resulting effect observed by a telescope. It was found that the dark lines of the spectrum materially changed their positions as different colourless gases were used; and that, by subjecting the spectrum to the absorptive influences of chlorine, nitrous acid vapour, the vapours of iodine, bromine, &c., numerous dark, and some luminous bands not previously observed, were brought into view. The spectra produced by coloured flames was also examined, and many curious conditions observed. Dr. Miller had sought to ascertain if any relation could be found between the chemical characters of the bodies under examination and their properties of exhibiting Fraunhofer's lines; but as yet no such relation could be detected.

'Recent Experiments on Ozone,' by Prof. Schönbein.—Prof. Schönbein was first induced to undertake his researches from the obscurity which rested upon the phenomena of the odour produced during the galvanic decomposition of water, resembling the smell of an electrical machine, and during thunder storms. In pursuing these researches, the author was led to the discovery, that the smell was always developed at the positive pole; that it was capable of being preserved in closed bottles; that heat destroyed it, and that many of the metals had also the same power. Experiments were made with a view to discover some means of procuring ozone easily; and after the trial of a great many bodies, it was found that phosphorus was particularly suited for the purpose. If a piece of phosphorus is placed in a bottle of common air, when maintained in a moist state, it readily produces this peculiar principle, on which the electrical smell depends. Several experiments were shown to illustrate the effects of ozone in bleaching litmus paper and paper coloured with indigo, or a solution of that substance. If powdered iron or silver are placed in vessels containing ozone, the smell is immediately removed, and the metals exhibit a kind of oxydation. Other bodies were named as producing a similar result; and many chemical decompositions were found to arise from exposure to the action of this peculiar principle. Solution of iodide of potassium is rapidly decomposed, iodine being set free; this was shown by a mixture of this salt with starch, which, on being exposed to the action of ozone, turned blue by the formation

of iodide of starch. Bromide of potassium was also decomposed by this principle, and bromine liberated. Salts of iron were shown to undergo the same changes. A number of organic bodies, both vegetable and animal, destroy the ozonous smell. If ozonized air be made to pass through a tube, and this tube gently heated, all the properties of ozone are destroyed. This was shown by experiment. By the inspiration of ozone, similar effects are produced on the lungs to those resulting from chlorine and bromine. A mouse was killed in five minutes, and the experimentalist himself was seriously affected by breathing an atmosphere charged with this odour. By electrolysis, gold or platina points are necessary for the development of ozone. The electrical brush in all cases produces the same effects as those above described; all the decompositions can be produced, and the same smell is distinctly evident. In this case, as in the other, heat and some of the metals also destroy the odour. Endeavours have been made to procure ozone in an isolated state, but they have not been successful. Ozone, although at first supposed to be an elementary body, was afterwards considered as a compound of oxygen and hydrogen. The fact of heat destroying this peculiar odour, at once shows, that this principle is produced from the elimination of an oxygen compound from the decomposition of water. This is quite in accordance with the views entertained by Mariniac, who has pursued the investigation with great industry, and who has published a memoir, in which his views are luminously set forth. The author of this report is of opinion, that ozone will turn out to be a compound isomeric with the binoxide of water. A theoretical view of the production of this body was then entered into. The ordinary action of phosphorus undergoing oxydation in the atmospheric air was explained, and the remarkable fact stated, that although phosphorus was luminous in moist air, it was not so in perfectly dry air. Ozone may now, therefore, although long regarded by Prof. Schönbein as an elementary body, be looked upon as, in all probability, a tritoxide of hydrogen. Its bleaching properties are very remarkable, and it may possibly be of considerable practical utility.

'Experiments on the Spheroidal State of Bodies, and its Application to Steam Boilers, and on the Freezing of Water in Red-hot Vessels,' by Prof. Boutigny.—Prof. Boutigny, who made his com-

munication in the French language, first proceeded to show that a drop of water projected upon a red-hot plate does not touch it; but that a repulsive action is exerted between the plate and the fluid, which keeps the latter in a state of rapid vibration. At a white heat, this repulsion acts with the greatest energy, whilst it ceases, and the ordinary process of evaporation takes place at a brown-red heat. The temperature of the water whilst in the spheroidal state is found to be only 96°, and this temperature is maintained so long as the heat of the plate is kept up. To bring this water to the boiling point (to 212°), it is therefore necessary to cool the plate. These phenomena are explained by M. Boutigny on the supposition that the sphere of water has a perfect reflecting surface, and consequently that the heat of the incandescent plate is reflected back upon it; and some experiments have been made, which show that this is the case, the plate becoming visibly redder over those parts on which the vibrating globule played. Several experiments were made in proof of this necessary cooling to produce ebullition. The red-hot plate, with its spheroidal drop, was removed from the spirit-lamp, and after a minute or two, the water began to boil, and was rapidly dissipated in steam. Ammonia and ether were shown, although so exceedingly volatile, to act in the same manner; the ether, however, being decomposed whilst in the vibratory condition, in the same manner as it is by the action of platina wire, forming a peculiar acid. Iodine put upon the heated plate became fluid, and revolved in the same manner as other fluids, no vapours escaping whilst the high temperature of the metal was maintained; but when allowed to cool to the point of dull redness, it was immediately dissipated in violet vapours. The nitrate of ammonia fused on the glowing hot plate, and vibrated with great energy; but on cooling the capsule, the salt entered into vivid combustion. The repulsive action was shown by plunging a lump of silver at a glowing red heat into a glass of water. As long as its bright redness was maintained, there was no ebullition; but as it slowly cooled, boiling took place. In this experiment, it appeared as if the glowing metal formed around itself an atmosphere; and the contiguous surfaces of the water appeared like a silvered plate. The application of the principles involved in these phenomena to the tempering of metals was then explained. If a metal to be tempered is in a highly

incandescent state, the necessary hardening will not take place on plunging it into water. It is, therefore, necessary that a certain temperature should be observed. Experiments were made to show that the repulsive power of the spheroidal fluid existed, not merely between it and the hot plate, but between it and other fluids. Ether and water thus repelled each other, and water rested on and rolled over turpentine. The bursting of steam-boilers came next under consideration; and it was shown that many serious explosions may be referred to the phenomena under consideration. In a great many cases, the explosions have occurred during the cooling of the boilers after the withdrawal of the fire. An experiment was shown in proof of the view entertained by M. Boutigny. A sphere of copper, fitted with a safety-valve, was heated, and a little water being put into it, it was securely corked up, and withdrawn from the lamp. As long as the metal remained red, everything was quiet; but upon cooling, the cork was blown out with explosive violence. The concluding experiment excited great interest. The production of ice in a vessel at a glowing red heat was a result so anomalous, that every one was desirous of witnessing the phenomenon for himself. It was beautifully performed by M. Boutigny, in the following manner:—A deep platina capsule was brought to a glowing red heat, and at the same moment, liquid sulphureous acid, which had been preserved in the liquid state by a freezing mixture, and some water, were poured into the vessel. The rapid evaporation of the volatile sulphureous acid, which enters into ebullition at the freezing point, produced such an intense degree of cold, that a large lump of ice was immediately formed, and being thrown out of the red-hot vessel, handed round to the company in the Section.

Mr. G. Rennie referred to some experiments of his own, in confirmation of M. Boutigny's views.

FRIDAY.

SECTION C.—GEOLOGY AND PHYSICAL GEOGRAPHY.

'Report on the Microscopic Structure of Shells,' by W. B. Carpenter, M.D.—This report formed the continuation of last year's [*Journ. Nat. History, p.* 442], on the minute structure of the skeletons of Bivalves and Echinodermata. Dr. Carpenter stated that he had

lately examined a recent Terebratula preserved in spirits, and ascertained that the perforations in the shell, before described, were filled up in the living animal by membranous cœca, containing cells, forming, as he considered, a glandular apparatus, though its connection he had not yet been able to trace. He then described the structure of those bivalve mollusks, in which the mantle is more or less closed as being generally less characteristic than that of the families already described, their texture being apparently more homogeneous; and the membranous residuum, left by the action of acid, being less distinct. Frequently, however, traces of a cellular origin were to be seen in shells whose general texture was most homogeneous: sometimes it was seen in the shell, and not in the decalcified membrane, and frequently in the membrane when no traces of it were visible in sections of the shell. Hence Dr. Carpenter felt himself justified in regarding all shells as originating in the secreting action of the cells forming the superficial layer of the mantle; these cells remaining persistent and separate in some cases, whilst in others they coalesced. The peculiar tenacity of the cellular membrane in *Pinna* and its allies was attributed to the presence of an intercellular horny matter, between the true cell-walls; the same substance being elsewhere thrown out upon the surface of the layer, as an epidermis or periostracum. Among the shells under consideration in the present report, those of the family *Myida* were particularly distinguished by their evident cellular structure; the genus Pandora formerly referred to as one of the most aberrant and exceptional in the structure of its shell, was now shown to be connected with the surrounding families by Mya, Thracia, Anatina, and other genera of Myida, whose characters were of an intermediate nature. In the class Echinodermata, Dr. Carpenter extended and confirmed the results he had before given respecting the minute structure of their skeletons, which preserve a remarkable conformity throughout the group, extending to the small calcareous plates met with in the Holothuridæ. Dr. Carpenter had also ascertained that the same minute structure existed in the Nummulite with the small existing foraminifera described by Ehrenberg; but that the supposed nummulites brought by Mr. Pratt from Bayonne presented several forms of structure entirely distinct from that of the true nummulite.—Mr. Charlesworth thought that extreme caution should be

used in the attempt to determine the limits of genera and species by the aid of the microscope. An experienced microscopic investigator, Mr. Nasmyth, considered the minute structure of the fossil ivory in Mr. Koch's collection of Mastodon bones, to indicate six or seven species, while Prof. Owen, taking external characters, came to the conclusion that all these remains were referable to the *Mastodon giganteus* of Cuvier.

'On the Agency of Land Snails in forming holes and trackways in Compact Limestone,' by Dr. Buckland.—This notice was a continuation of one made at the Plymouth meeting, in which the author ascribed certain perforations discovered by him on the under side of ledges of limestone rock at Tenby, Boulogne, and Plymouth, to the agency of an acid secretion of land snails, which resorted to these perforations daily for shelter. The additional instances now described were discovered by Dr. Buckland in Cumberland, during a visit made in 1842, in company with Mr. Hopkins; at Cannington Park, in Somersetshire, by Mr. Baker; in the string-courses of the Roman castle at Richborough, built of Kentish rag; in the roof of the cromlech at St. Nicholas, near Cardiff; in the rock work in Mr. Dillwyn's garden, brought from Gower; and in St. Mary's Abbey, at York. Dr. Buckland exhibited specimens of limestone rock from several localities, showing perforations occupied by snails, and grooves or furrows leading to the perforations, and he insisted that these were unlike those produced by any marine animal, or by atmospheric causes. The perforated rocks were stated to be only found in districts affording a rich vegetation, and were always met with immediately on passing from a slate region, or one entirely composed of limestone, into another covered with more luxuriant herbage. Dr. Buckland attached great importance to the perforations at Richborough Castle, which, he said, afforded a measure of the time necessary for such operations. The deepest holes he had seen in limestone rocks never exceeded two or three inches, and he considered it probable that they had occupied several thousand years in their formation; the holes were only found in the hardest limestone rocks, because in all others they would be obliterated by atmospheric action.

'On a Topographical and Geological Map of Mount Etna and adjacent Country from actual Survey,' by Baron W. S. de Walter-

shausen.—The author illustrated his remarks by maps and diagrams of Mount Etna, exhibiting by different shades of colour the dates of streams of lava which had flowed from 215 different eruptions, and the exact position of all the minor craters, 750 in number, dotted over the region surrounding the principal elevation. The maps were on a scale of $\frac{1}{30000}$ of nature, and were still in manuscript, although now in the process of being engraved in Germany, accompanied by a detailed description of all the geological and topographical phenomena connected with it, illustrated by very numerous and elaborate drawings. This work is the result of above nine years' labour, chiefly on the spot. At one time Baron Waltershausen remained forty-two days in the neighbourhood of the summit, making his survey and observing the changes of the principal crater. The map contains a representation of the dykes of the Val del Bove. Those which are of diorite manifestly diverge from a central point a long way to the eastward of the present cone, which point the author supposes to indicate the centres of the elevatory forces at the time of the dioritic formations. The oldest rock in Etna appears to be a whitish trachyte, which appears in the Val del Bove, and at one or two other points on the eastern side.

Sir H. De la Beche stated that these maps had been laid down from trigonometrical survey, and were the most beautiful specimens of such work he had seen. He also alluded to the evidence of a crater of elevation entirely different from the small crater of eruption, and that the shifting of this principal crater was shown by the radiation of dykes from more than one point; these dykes being simply cracks filled with molten rock, forced up from beneath.—Baron von Buch remarked, that two circumstances were particularly worthy of notice—first, that the greater part of the lava did not flow from the principal crater, but from points as much as five miles distant; and secondly, that all the cracks formed during eruptions went upwards to the central crater.—Prof. J. Forbes observed that the section seen in the Val del Bove, exhibited most completely the mode of formation of the volcano, and afforded the best criterion for judging of the accuracy of the theory of volcanic elevation propounded by Von Buch. He pointed out the evidence of the progressive motion of the centre of elevation from ancient periods to the present time, a change

taking place by steps and indicated by the position of the dykes, which gradually partake more and more of the mineral character of those connected with the present craters. He next called attention to the circumstance that the central crater was situated on one side of a great dome-shaped elevation, for the formation of which something more than the successive deposition of lava streams had been necessary. The idea that the principal mass of a volcano like Etna might be formed in this way, had arisen from an erroneous estimate of the quantity of liquid matter erupted at any one time, of the manner in which it was spread out, the equality of its distribution, and the angle at which it could be consolidated. On the principle advocated by Mr. Lyell, that the greatest effect might be produced by small causes, multiplied indefinitely, it had been inferred that a mountain 10,000 feet high might be formed in a period proportionally longer than one of only 1,000 feet by the same means. In fact, that Etna might be formed by a long-continued series of eruptions such as produced the Monte Rossi. This Prof. Forbes considered quite impossible, for a reason pointed out by M. Elie de Beaumont, who, in describing Mount Etna, had seized upon many of its leading features, and given an explanation of its structure, fully borne out by Baron Waltershausen's elaborate survey. The sections in the Val del Bove exhibited vast numbers of alternating strata of ancient lavas, separated by thin layers of ashes or slags, more compact and more evenly distributed than those of modern date, having similar angles of inclination.—Mr. Hopkins remarked that there were three points of great importance to be considered: 1. The actual constitution of the great mass of Mount Etna, considered by M. de Beaumont a cone of elevation, and not of successive eruption; his argument being similar to that which geologists apply to ordinary strata, when they are found at an angle greater than that at which they could have been originally deposited by water. The approximate thickness of the beds of lava being the same as usual, they must have been brought into their inclined position by subsequent elevation. 2. The lines of contemporaneous dykes diverging from accurate centres; an arrangement which might have been inferred *à priori* from mechanical considerations. 3. The circumstance that there are distinct systems of these diverging

fissures, showing that the general conditions of the mass were such, that after one system was formed, their nature was so modified by time, that the same process might again take place from another centre, without being materially disturbed by the former set of fissures. If there had at any time been two contemporaneous centres of mechanical force, such modification in their effects would have been produced as to distinguish them from the effects of forces acting consecutively in different periods of time. In concluding, Mr. Hopkins remarked that the same phenomena were presented on a small scale in the constitution of a volcanic mountain, which might be expected on a much larger, wherever the earth's crust had undergone elevation. The theory that this crust rested on one uniform fluid surface, was opposed by the fact of the shifting of the points of eruption, a circumstance only explained by supposing a degree of interruption in the connection of the internal fluid.—Prof. J. D. Forbes described (at the request of Baron Waltershausen) an instance of a fissure produced by pressure from below, seen in a section of the Etnean mass. In this case the beds of lava appearing horizontal, but in reality dipping towards the observer, were fissured by a vertical dyke sending out horizontal branches between the layers of lava, horizontal layers being sent off from a vertical dyke. In the Val del Bove one dyke was seen standing out from a vertical cliff, in which the upper surface preserved its original form, and bore the trace of stream-marks.

Saturday.

'On the Coal Deposits of the Asturias,' by Mr. S. P. Pratt.—Mr. Pratt gave a general account of a section taken from the neighbourhood of Leon, in a north-west direction to the coast passing through Oviedo. The strata rise from beneath tertiary deposits which cover the plains of Leon and Castelli, at an angle of 30°, which soon becomes nearly vertical, dipping north-by-west. They consist of numerous alternations of grit and shale with thin beds of limestone, and contain within about three miles of their rise a bed of good coal, nearly nine feet thick. Between this point and the summit of the Pass, a distance of five leagues, several extensive faults occur, by which the dip is more than once reversed, and several large mountain masses of limestone appear, underlying the grits, &c.; this

limestone contains numerous fossils which indicate a period older than the mountain limestone, although several species are found intermixed, which can scarcely be separated from it. Hard grits and shales, highly inclined, succeed, and form the higher parts of the Pass, extending about a league beyond it to the north, when coal plants are found abundantly in the grits and shales; no coal, however, is seen until near Pola de Lena situate about three leagues from the top of the Pass; from hence following the road to Oviedo, in a distance of 10 miles, more than 70 seams of good workable coal are crossed near the upper part of the series a bed of conglomerate occurs, formed of rolled masses of grit, and limestone, and coal; another such deposit, probably exceeding 1,500 feet in thickness, appears near the lowest part of the series, in which the coal boulders are more abundant, varying from the size of an egg to a foot in diameter, and possess the same character with the coal of the associated beds; one good coal-seam occurs in the conglomerate, and two or three below it. The coal deposits are terminated by a narrow valley, beyond which the limestone rises from beneath them to a considerable elevation; a depression of the surface soon after occurs, forming a plain of cretaceous deposits of the Hippurite period, upon which the city of Oviedo stands, and which extends for 20 or 30 miles east and west. Beyond Oviedo to the north, the limestone again rises, and coal deposits appear between this point and the coast; in one of these the coal forms beds of from three to seven feet, interstratified with the limestone, which, with the shales that occur in it, contains an abundance of fossils, chiefly shells and corals, with but few traces of plants, whilst those before mentioned in the series south of Oviedo, were chiefly calamites, sigillariæ, and other coal-plants. Another of these deposits, containing the same fossils, crops out on the sea-shore near the port of Aviles, which is to form the termination of the north of Spain Railroad to Madrid. It appears, therefore, that, besides extensive coal-beds corresponding with those of England and other countries, this province possesses a considerable deposit belonging to an earlier period, which was probably the source of the boulders occurring in the conglomerate of the upper series. Connected with the coal, and always below it, are several beds of hæmatite, one of which is extraordinary, the pure unmixed ore being 50 feet thick, and

extending for a considerable distance; it appears from its mineralogical character to have been a mechanical or aqueous deposit.

Mr. Murchison remarked that the discovery of a coal-field as old as the Devonian system, although new, had not been improbable. Mr. Sedgwick and himself had discovered coal-plants in the Devonian rocks of the Rhenish provinces.—Sir H. De La Beche stated that the coal-plants were the earliest types of terrestrial vegetation yet known; in Devonshire they were found in that part of the culm, which was the equivalent of the millstone grit. Conglomerate containing boulders of coal in Pembrokeshire had been described by Mr. Logan, who referred to them in proof of the enormous period of time which must have elapsed between the deposition and consolidation of the beds of coal from which the conglomerates were formed, and the succeeding coal strata. In England hæmatite usually occurred in fissures and veins, but there was a bed of it in the Forest of Dean evidently deposited at the same time with the other strata; and this might be expected from the analogy presented by the extensive deposits of impure carbonate of iron as "bog-ore," still in process of formation.—Mr. Sedgwick observed that the conditions requisite for the formation of coal had occurred in every geological epoch subsequent to the great coal formation, and he therefore believed that it might have been also formed, and perhaps traces of it still existed in the very oldest rocks. He had examined the workings for hæmatite at Egremont, and ascertained that in this instance it was not a regularly bedded mass, but filled an ancient limestone cavern, the projecting portions of the roof being water-worn and polished; he thought it probable that much of the hæmatite in England had been deposited by aqueous agency in clefts and hollows, at the time of the new red sandstone, when the sea was charged to excess with per-oxide of iron.

'On the Denudation of South Wales and the adjacent Counties,' by A. C. Ramsay.—The object of this communication was to show the great amount of certain denudations, and the approximate periods at which they had taken place. In South Wales the older rocks are in general terms conformable, indicating quiet deposition. After the deposition of the coal measures, violent disturbances took place, curving and contorting all the strata from the coal measures downwards.

The conditions necessary for the continuance of the formation of coal were by these disturbances destroyed. The thickness of these rocks probably amounts to 25,000 or 30,000 feet; the Silurian rocks having a measured thickness of 10,000 feet, the old red sandstone from 4 to 7,000 feet; the mountain limestone varying from 50 to 2,000 feet; and the coal measures, as ascertained by Mr. Logan, attaining a thickness of from 10,000 to 15,000 feet. This total thickness is not supposed to exist at any one spot, but as each formation required the same time for its deposition as indicated by its maximum thickness, the argument as regards time is the same as if they had all been deposited at one place continuously. Most of these strata were therefore consolidated before the disturbances; and when their great mass and extent is considered, it will be obvious that no small forces could have produced such large effects. It was Mr. Ramsay's opinion that they could only be accounted for by lateral pressure such as would be produced by the "attempt of a solid crust to accommodate itself to a diminishing mass below in a refrigerating sphere." These curves were not produced by forces acting at detached points, the small flexures being but parts of much larger curves affecting the whole country. In illustration, Mr. Ramsay exhibited coloured sections representing the outline of the country and dip of the rocks. From these sections Mr. Ramsay had obtained data for calculating the probable height of the land at various periods. Considering the magnesian conglomerate as the *beach* of the new red sandstone sea, the hills of South Wales and the adjacent counties must have attained various elevations, ranging from the level of the sea to at least 15,000 feet high. In a section from Glastonbury Tor to Bristol, the mountain limestone and coal were entirely cut away by the new red sandstone, and oolitic seas. In Glamorganshire and the country towards the Malverns, the coast had been denuded back to the extent in some places of nine miles, and a mass of strata removed sufficient to have formed a deposit of new red sandstone 500 feet thick, over an area of from 200 to 300 square miles. A country possessing mountains of such elevation must have enjoyed every variety of climate, from the tropical to the arctic. The plants of the lias and oolites were supposed to be tropical, whilst the insects discovered by Mr. Brodie in the lias were mostly those belonging to a temperate climate, inter-

mingled with some tropical forms. Mr. Forbes had mentioned a similar admixture taking place on the shores of the Egean at the present day, the insects of the mountains being washed by floods into the sea mingled with those requiring a higher temperature. And as there was evidence of *rain* having fallen in the period of the new red sandstone, in all probability it had continued in the lias. During all the oolitic period the land appears to have continued to rise towards the west, so that the oolitic strata were deposited in a constantly diminishing area; half were already above water, while the upper beds were depositing, and all the high land which was not already destroyed was above water. Denudation by the sea did not therefore further progress at this period in what is now South Wales. During the cretaceous period a partial depression took place, and the sea may again have crossed the Severn, and washed against the old coats; Mr. Ormerod has found chalk flints abundantly on the banks of the Severn near Chepstow. Again a rise took place before the deposition of the London clay, but the disturbances by which the chalk was elevated were comparatively of a tranquil nature. After the deposition of the London clay, Mr. Ramsay therefore considers there may still have been mountains in Wales of the great height already indicated, and to remove these the land must have again gone down to a depth at least corresponding to the height of the highest hills which now exist in Wales; on the tops of some of these, as on Moel Tryfan, there is drift, with recent marine shells, at a height of 1,500 feet. The whole change from this condition to the present, must have been effected during the tertiary period, and part of it immediately prior to our own.

Prof. Sedgwick reviewed the evidence afforded by Mr. Ramsay's communication of the successive changes which had taken place on the surface of the earth in the most remote periods; he alluded to the lapse of time required for the accumulation of such vast masses of shingle and sediment formed of the destruction of pre-existing rocks, for the growth of coral-reefs, and for the formation of the coal-measures from the accumulated vegetation of a long succession of peats and peat-bogs. During the progress of these physical changes, the population of the ancient sea had been repeatedly destroyed and renewed, not suddenly, but gradually and in accordance with the opera-

tion of laws. Nor did he feel any difficulty arising from the number and complexity of these changes, since they had been effected in an eternity of past time, with the hand of Omnipotence to work in it.—Dr. Buckland remarked that the coal-measures must have suffered a great amount of denudation since the displacements which the strata had undergone were not visible on the present level surface. Sir James Hall had constructed similar sections to those of Mr. Ramsay's, demonstrating that many thousand feet of strata had been removed, as he supposed, at the time of the upheaval of the country, by the action of waves upon the broken summits of the hills. Dr. Buckland considered that in many places the denuded strata had not been so thick as in those where they still remain, because the most extensive formations were local, and thinned off towards their shores. His greatest difficulty was in accounting for the wreck of these formations, there being no adequate amount of detritus visible in any of the newer formations. In some strata pebbles were exceedingly rare. He did not think much importance could be attached to the climatal character of fossil insects; he had himself seen on the perpetual snow of Etna the insects of the warmer regions below: but if, as supposed by Mr. Ramsay, there had been in Wales mountains 15,000 feet high, at the period of the London clay, it might remove in some degree the objection to his theory respecting the existence of glaciers in that country at a somewhat later period.—Mr. Hopkins discussed the mechanical causes of the phenomena of elevation, to determine whether these had resulted from a gradual and progressive force, or from reiterated paroxysmal action, requiring attention not only to the character of the elevation, but also the phenomena of denudation. With respect to the direction of the force, the greatest difficulty was in accounting for the horizontal thrust indicated by the contortions of the strata; if wave-like undulations were produced in a semi-fluid below the surface, as conjectured by Prof. Rogers, they might be communicated to the solid crust, but such a condition was *dynamical*, and would not necessarily produce any permanent results; but if the whole undulating area were elevated simultaneously and then subsided, certain portions would sink down more than others, and from the pressure of the arches thus constituted an unlimited horizontal force would be produced,—within, however, certain fixed

points, which must exist. Mr. Phillips had ascertained, that whenever a fault was inclined, the upward movement was always on the *inclined side,* a law resulting from the view just stated. The process of denudation Mr. Hopkins considered as either littoral, or superficial—from the action of currents on the sea-bottom; it went on simultaneously with deposition, and would be more rapid after convulsions had exposed large broken surfaces to its action, a process not consistent with the preservation of delicate organic remains. So far as the removal of these immense masses of strata had resulted from littoral action, the process must have been slow, but unquestionably from this source, denudation, was derived the materials of all those strata which have been deposited by water.—Sir H. De La Beche stated that the "ground-swell" was the most destructive form of sea-action on a coast; he described the appearance of gravelly beaches along the Mendips from Shepton Mallet to the Bristol Channel, re-appearing in Glamorganshire, where the lias conglomerate was 70 feet thick, formed of the detritus of the subjacent rock; these beaches indicated the elevation of the country at that particular time. In South Wales the faults had been formed after the strata were contorted.—Mr. Phillips observed, that when a good general solution for any class of phenomena had been obtained from clear data, it gave the power of interpreting other similar circumstances. The original continuity of strata in many places where now absent, was sufficiently proved by the manner in which they appear at the surface, their dip, direction, &c. Some rocks were more continuous than others, particularly the limestone, which sometimes preserved the same aspect and thickness for 60 miles, but here thinned out in one direction. The observations of Mr. Ramsay respecting denudation might be extended along the Malverns and to North Wales and Ireland.

'On the Geology of New Zealand,' by Dr. Dieffenbach.—New Zealand forms a group of mountainous islands nearly as large as England and Wales, and its geology is rendered difficult by the primitive forests that fringe the coast, or, where these have been destroyed, by impenetrable thickets of the esculent fern. The fundamental rock is everywhere *clay slate,* frequently containing greenstone dykes, as at Port Nicholson, Queen Charlotte's Sound, and Cloudy Bay; in the neighbourhood of the dykes the clay slate

sometimes assumes the character of a *roofing slate.* On the banks of the rivers Eritonga and Waibo are terraces, or horizontal plateaux, 50 feet high, formed of boulders of the oldest trap-rocks, and similar terraces are seen on the sea coast round Cape Palliser, 50 or 60 feet above the sea. *Anthracite coal* crops out in the small harbour of Wangarrie on the west coast of Middle Island, and there is a thin seam of anthracite in the hard grey sandstone on the east coast of the Northern Island. *Limestone* is described as occurring in the harbours of Kauria and Waingaroa, on the west coast of the Northern Island; it is crystalline, and contains fossils of the genera Pecten, Ostrea, Terebratula, and Spatangus. Limestone is also found on the river Kaipara in the Bay of Islands, and *Copper pyrites* have been obtained from the great Barrier Island, where it forms veins in the clay slate. The coasts are in many places fringed with recent horizontal sedimentary deposits, consisting of loam, with fragments of wood and tree ferns, blades of the typha, &c.; and on the northern island the coast is often formed of volcanic conglomerate, containing magnetic iron sand near Cape Egmont, and turritellæ and oyster shells at the harbour of Parenga; near Tauranga, it is composed of decomposing tufa, containing lignite and shells of Pectunculus, Natica, Pyrula and Ancillaria. The small rocky islands of trachyte, lying off the coast of Northern Island, also bear marks of wave-action to the height of 100 feet above the present sea level. On the western coast of this island formations of sand are now accumulating, driven over the forests by the prevalent westerly gales. The interior of the Northern Island affords but a scanty vegetation, and the surface is everywhere covered with ordinary volcanic productions, derived from the lofty central group of mountains, some of which are extinct, others still active volcanoes; the lava appears to have been principally erupted from the base of the craters. The highest of these craters are Tongariro, 6,000 feet in elevation, according to Mr. Bidwell, and Mount Egmont about 9,000 feet, by Dr. Dieffenbach's thermometrical observations. There are also many lakes which appear to occupy ancient craters. The mountain chains of the Middle Island are supposed to consist of primary rocks; quartzose sandstone and greywacke are met with at the height of 3,000 feet; the lofty pyramidal summits are covered with snow, and deep

narrow valleys separate the various ridges, and radiate from the central cones. Dr. Dieffenbach enumerates many localities at which he observed mineral springs, particularly between the Bay of Islands and Hokianga, where their temperature varied from 124° to 154°, and having an alkaline taste; the surface was covered with sublimations of sulphur. Along the delta of the Waikato, hot-springs rise from the escarpments of the hills, forming deposits like those of Iceland and St. Michael, Azores, containing 75 per cent. of silica. There is also a cold silicifying spring near Cape Maria. Dr. Dieffenbach has examined into all the traditions respecting the existence of the *Moa,* or great bird of New Zealand, and concludes that it has never been seen alive by any natives of New Zealand; the rivers in which its bones have been found flow between banks from 30 to 60 feet high, and as they are continually changing their course the remains of the moa may have been derived from tertiary fluviatile strata.

Friday.

Section D.—ZOOLOGY AND BOTANY.

The Rev. L. Jenyns read a paper 'On the Turf of the Cambridgeshire Fens.'—This turf was not formed by sphagnum, as most peat, but from various species of aquatic plants which had been accumulated for a long period of years above the remains of forest trees which lie buried at the bottom of the moor. There are two distinct kinds of turf, the *upper* and the *lower*. The former is the more compact and heavy of the two. The latter consists entirely of the bark, wood, and branches of the submerged trees. The turf is not now rapidly formed on account of the improved system of drainage. Formerly it was supposed to grow about twenty inches in sixteen years.

Dr. Falconer said, that he had observed in Cashmere, at the bottoms of lakes, turf of a very similar kind to the lower bed just mentioned. It consisted of the remains of various aquatic plants, as Chara, Potamogeton, Utricularia, and Nelumbium. The inhabitants obtained it from the bottom of the lake by means of a rake, and used it as fuel.—Mr. Babington stated that the character of the Scotch and Irish bogs was different from that of the fens

of Cambridgeshire. He had seen peat procured in Ireland from the bottoms of ponds in the same way as described by Dr. Falconer in Cashmere.—Mr. H. E. Strickland had seen peat in Ireland converted into a substance as hard as jet, so that it might be used by the turner. The formation of this peat threw much light on the formation of coal. There could be no doubt that our coal beds were some of them formed in the manner of bogs, whilst others resulted from vegetable matter deposited at the bottom of the sea.—Mr. Selby had seen peat quite solid and bright as amber.—The Bishop of Norwich stated, that the trees buried in the bogs of Lancashire exhibited marks of being burnt, and many of them had on them the strokes of the axe. Mr. Dowden pointed out the remarkable fact in Mr. Jenyns's observations that the light turf was undermost. The laws of nature were better observed in Ireland, where the heaviest turf was at the bottom.—Mr. Murchison remarked, that it was an extraordinary fact that there were no bogs in Russia, and yet throughout that country there was a great extent of mountain limestone as in Ireland, the most boggy country in the world. He supposed it was attributable to the character of the climate. In Ireland it was always raining, and moisture favoured the development of bogs.—Mr. R. Ball, of Dublin, had lately observed a number of trees which were blown down in 1839, covered over with grass, and the interspaces between the trees was filling up with vegetable matter, and in the course of time he believed they would form a bog.—Prof. Oldham, of Dublin, observed, that there was a difference in the mountain limestone of Ireland and Russia, inasmuch as the former was covered with beds of clay, and it was on these clay beds that the bogs were formed.

Sir R. Schomburgk read a description of the Murichi, or Ita Palm, of Guiana. This tree grows from the Llanos of Cumana to the western tributaries of the Rio Negro and the mouth of the Amazon, or over an area of 550,000 square miles. It was called by Father Gumilla the *arbol de la vida*, or tree of life, on account of its various uses. It is of the greatest importance to the inhabitants of the country in which it grows. The trunk and its leaves are used for various household purposes. The sap is a saccharine fluid, much drunk by the natives. The flowers afford a sweet fermentable

liquid, resembling champagne. The pith of its trunk affords a kind of sago. Even in its decay, this palm is of use, and affords a delicacy to the Indians, which likewise many colonists do not refuse, namely, the larva of a large beetle. The *Curculio palmarum* is found in large numbers in the pith when the trunk is near its decay, and which, when boiled or roasted, resembles in taste the marrow of a beef bone. Its average height is about 50 feet, and it has been observed growing at a height of 3,000 to 4,000 feet above the level of the sea.

Prof. Allman laid before the Section a monstrosity occurring in *Saxifraga Geum.* The three external verticels of the flowers were normal, but between the stamens and pistil there was developed a series of adventitious carpels crowded upon the margin of a cup-like production which surrounds the lower half of the pistil. These adventitious carpels were characterized by their backs being turned towards the axis of the flower. The carpels bear ovules on their margins, which acquired a very considerable degree of development, becoming completely anatropous, like those in the normal ovary. Dr. Allman explained this monstrosity by supposing the existence of a series of secondary axes, which are given off in a whorl between the stamens and the primary axis of the flower. These axes terminate in imperfect flowers, of which the additional carpels are the only remains.

Prof. Henslow exhibited a specimen of *Papaver orientalis,* in which the filaments of the stamens were converted into bodies bearing ovules.

Prof. E. Forbes read a paper 'On the Distribution of Endemic Plants, more especially those of the British Islands, considered with regard to Geological Changes.'—The author stated that the hypothesis of the descent of all the individuals of a species, either from a first pair, or from a first individual, being assumed, the isolation of assemblages of individuals from those centres, and the existence of endemic or very local plants remains to be accounted for. Natural transport, the agency of sea, rivers, and winds, and carriage by animals or through the agency of man, are means in the majority of cases insufficient. The true cause the author proposed to seek in an ancient connection of the outposts or isolated areas with the original

centres, and the subsequent isolation of the former through geological changes and events, especially those dependent on the elevation and depression of land. Selecting the Flora of the British Isles as a means of testing his theory, he divided its vegetation into five Floras: first, a west Pyrenean, confined to the west of Ireland, and mostly to the mountains of that district; second, a Flora related to that of the south-west of France, extending from the Channel Isles across Devon and Cornwall to the south-east, and part of the south-west of Ireland; third, a Flora common to the north of France and south-east of England, and especially developed in the chalk districts; fourth, an Alpine Flora developed in the mountains of Wales, north of England and Scotland; and fifth, a Germanic Flora, extending over the greater part of Great Britain and Ireland, mingling with the other Floras, and diminishing, though slightly, as we proceed westwards, indicating its easterly origin and relation to the characteristic Flora of northern and western Germany. The author then went into details pointing out the circumstances which gave a probable age to each of these British Floras, and the geological changes which had occurred to isolate them from Floras of other parts of Europe, with which they were formerly in connection, and with which they had a common parentage. He maintained, in conclusion, that the peculiar distribution of endemic animals, especially of the terrestrial mollusca, bore him out in these views. He proposed to pursue the subject in detail, with reference to both animal and vegetable life, in connection with the researches of the Geological Survey.

This paper produced a long and interesting discussion. Mr. J. Ball argued against the hypothesis of there being only a single species created. If there were but one individual we were not in a position to say what were its characters from our present forms. He saw no objection to the view that the same species might be created at two distinct periods of time, as well as of space.—Prof. Phillips would not enter into the question of the hypothesis, but as a geologist he could say, that the changes required to produce the isolation of the Floras spoken of by Mr. Forbes, were not greater than must have taken place to produce other well known geological phenomena. He believed the views of Prof. Forbes of great importance; and, in re-

gard to the examination of the distribution of extinct forms of animals and vegetables, would furnish a mode of investigation of the greatest value.—Mr. C. C. Babington stated, that if the presumed geological phenomena of Prof. Forbes could be granted to have taken place, that would be a strong argument in favour of the hypothesis he had adopted. The great difficulty in the way of supposing the creation of but one individual of a species was their frequent distribution over various parts of the world.—Prof. Forbes, in reply, stated that if the hypothesis of a single pair or an individual of each species were not granted, there was an end to all palæontology and its value in geological inquiry. If the hypothesis of descent be not true, then the deduction of geologists from it are erroneous.

Friday.

D.—Sub-section, ETHNOLOGY.

Admiral Sir C. Malcolm in the chair.

Dr. R. G. Latham 'On the Ethnography of the American Languages.'—He opened by explaining the extent of the Esquimaux tongues, by pointing out the character of their locality as being the one that we should naturally expect to find transitional to the Fo language of America and Asia, stated, however, that they had been cut off on both sides by broad lines of separation. These lines he considered exaggerated. Between them and the Athabascan, between the Athabascan and Cooloch, between the Cooloch and Oregon, between the Oregon and Californian, he could draw no definite lines. The Californian passed into the Mexican, the Mexican into those of South America. On the other hand the Curile, Corean, and Japanese tongues were akin to the Esquimaux, so were the Siberian. He was satisfied that the common view was the true one; viz. that the Esquimaux languages connected the Old and New Worlds. He further added that the glossarial affinities of the Polysynthetic tongues were as real as their grammatical analogies.

The American Minister remarked, that the divisions of Dr. Latham did not agree with those recognized by the American scholars. He observed that the languages of the United States were classed in eight divisions; that between these there was certainly a general affinity such as between the more distant languages of the Old

World; that the difference between the American tongues was not so great as to make against the general unity of the human race; but that still it was so great as to render the processes by which alliances were shown between *them,* convertible towards showing alliances between any other languages whatever. He did not see what sense Dr. Latham gave to the word *affinity*, and desired to see the details by which the eight isolated classes were run into each other, and the particular facts by which the current divisions were broken down. The contrast between the grammatical analogy and the glossarial differences of the American tongues was generally recognized. Dr. Latham, however, instead of explaining it, denied its existence.—Dr. Latham replied, that he had abstained from details merely on the score of time; that he would now enter on them but briefly; that he must be excused if he supposed that they were but partially acquainted with the details of transatlantic scholars in this department, but that he would now take up the subject in special regard to the attention with which the Honourable Minister had paid to his statements from the point where they had left it. He differed with Gallatin and others, but he owned that he combated them with weapons which they themselves supplied. He spoke with praise upon the pains taken by the American War Department to procure the Indian vocabularies. In respect to the Natchez, Uche, Attacapa, Adaine, and Chetimacha vocabularies, he believed that Gallatin himself only meant his groups to be *provisional.* The division, however, between the Algonquin and Iroquois groups was considered real. This he broke down. Both were allied to third languages, *e. g.* the Eskimo. Both could be shown allied to each other, if we dealt with many dialects *en masse.* The Cherokee was Caddo, and as such Catawba also. The question between the Creek and Choctah tongues, was one of definitions only. Exceptions might be taken to his modes of indirect and collective comparison, but he believed them to be legitimate and recognized instruments of criticism.

'On an Apparatus for Measuring and Registering two dimensions of the Human Frame, the Height of the Body and the Space from the extremity of the Fingers of one Hand, to the extremity of the Fingers of the other, the arms being extended horizontally.'—The adoption of the measurements proposed, the author contends will

furnish a more accurate means of identification than the method now in use, and at the same time give important data for ethnological inquiry. The apparatus consists of two graduated scales, each fitted with a sliding gnomon. Taking the corner of the room as a convenient perpendicular, the scales are fixed against the wall at a certain distance from the floor and corner of the room and at certain angles.

Monday.

Section A.—MATHEMATICAL AND PHYSICAL SCIENCE.

'Remarks on the Periodicity of Magnetic Disturbances,' by the Rev. H. Lloyd.—When we examine, for the first time, the chart of the changes of one of the magnetic elements during a day of disturbance, we do not hesitate to pronounce that the causes which produce these changes, so apparently capricious, belong to the class which, from our ignorance of their laws, we are accustomed to denominate "accidental" or "irregular." Experience, however, has shown that these phenomena, and therefore also the forces which produce them, are *subject to laws*, which require multiplied observation alone for their development. A few months of systematic observation is sufficient to show that these apparently abnormal movements of the magnet recur more frequently at certain hours of the day than at others. Prof. Kreil seems to have been the first to notify this remarkable fact. In a letter addressed to M. Kupffer, dated in January 1839, he observes, that "all hours of the day do not appear to be equally favourable to the development of this phenomenon;" that disturbances begin "much more frequently in the evening than in the morning hours, and "hardly ever begin in the latter hours of the forenoon." In a letter addressed to Col. Sabine, dated in July 1840, Prof. Kreil has entered more minutely into the question, with the light of the observations of an additional year. He there observes, that "the *least* disturbance takes place in the declination from 8 to 10 A.M., and the *greatest* from 8 to 10 P.M.;" that "the declination is *increased* by the disturbances of the forenoon and middle of the day, and *diminished* by those occurring in the evening hours;" that the effect of disturbances upon the horizontal intensity is, in general, a *diminution* of that element, this diminution being however more considerable "during the hours of the night and morning, than in the forenoon and afternoon." A more elaborate examination of this

question has been since made by Col. Sabine, in the discussion of the results of the first two years' observations, made at the Magnetic Observatory of Toronto, under the direction of Lieut. Riddell. The mode of examination is, for the most part, the same as that of Prof. Kreil,—namely, to *separate* the individual results, which differ from the monthly mean, corresponding to the same hour, by a quantity exceeding a certain arbitrary limit; to treat them as the effects of perturbing causes; and to examine the *frequency of their occurrence* at the several hours of regular observation. By this mode of examination Col. Sabine has been led to the result—a result partly agreeing with and partly differing from that deduced by Prof. Kreil—that "the causes which produce *easterly* deflexions have their maximum frequency of effect at ten hours, and those which occasion the *westerly* deflexions their maximum at twenty hours. The minimum of both occurs nearly at the same hour, viz. about two or four hours." Analogous conclusions are deduced respecting the disturbances of the horizontal intensity. These disturbances, which are on the whole subtractive, have their minimum at 4 P.M., the hour of maximum intensity; their maximum, on the other hand, occurs about the time of the nocturnal minimum of the intensity, or from ten to sixteen hours. Col. Sabine then proceeds to compare the monthly means at the several hours of observation, as deduced from the *whole* body of the observations, and as deduced from the *remaining* observations, when the excessive deflexions already referred to are laid aside. Of the propriety of this separation, and of the results thence deduced, Dr. Lloyd said that he would not now speak; as the remarks which he had to offer had no immediate connection with that question. With respect to an *annual period* in these remarkable phenomena, Prof. Kreil and Col. Sabine have arrived at different conclusions. According to Prof. Kreil, "the perturbations are much more frequent in the winter than in the summer months;" and that, not merely because the cause which produces the regular diurnal change is then more feeble, but also because (according to Prof. Kreil) the disturbing forces are then actually of greater intensity. According to Col. Sabine, "the disturbances [of declination] appear to be distributed throughout the year without any marked inequality either as to number or direction," except that their number appears to preponderate somewhat in the month of October. With respect to the horizontal

intensity, Col. Sabine appears to agree with Prof. Kreil, and to find that the number of observed disturbances of that element is greater in the winter than in the summer months.

Having thus stated the conclusions which have been hitherto drawn, in connection with this subject, Dr. Lloyd proceeded to lay before the Section the results to which he had himself arrived, by a different mode of investigation, as applied to the observations made in the magnetical observatory of Dublin.

The problem which he proposed to himself had for its object to determine the *law of probability* of disturbances, as dependent upon the hour of the day, and upon the season of the year—a question, the solution of which will be seen to be of very great importance with reference to any physical theory of the phenomenon. The methods hitherto applied, although they indicate in a general manner the times of greater and less disturbance, do not solve this question. In the investigations of Prof. Kreil and Col. Sabine, no account is taken except of disturbances exceeding a certain arbitrary limit; and, with respect to these, the results are not combined in such a manner as to give the law in question. The deduction of this law, although somewhat laborious, is nevertheless simple in principle. We have only to take differences between each partial result and the monthly mean corresponding to the same hour, and to combine these in the same manner as the errors of observations (to which they are analogous) are combined in the calculus of probabilities. Thus, the square root of the mean of the sum of the squares of these differences is a quantity analogous to the *mean error*, in the partial observations of a constant quantity; and *the probable disturbance* at any hour is inferred from this, by multiplying it by a constant factor. The values of this function (which Dr. Lloyd proposed to call the *mean disturbance*) have been deduced for the several hours of observation in each month. The corresponding values for the entire year are deduced from those of the separate months, by a repetition of the same process; they are given, reduced to minutes of arc, in the following table:—

1	3	5	7	9	11	13	15	17	19	21	23
2'·16	2'·09	1'·09	2'·45	3'·46	4'·10	2'·81	2'·52	2'·16	1'·93	1'·87	1'·94

The *mean daily disturbance,* deduced in a similar manner from the mean disturbance corresponding to the several hours, is 2′·56. It will be at once seen, from the mere inspection of these numbers—or, still better, by projecting them in a curve—that the mean disturbance follows a law of remarkable regularity, as depending upon the hour of the day. During the day, i. e. from 18 to 6 hours, it is *nearly constant.* At 6 hours, i. e. at sunset, it begins to *increase;* it arrives at a *maximum* a little after 10 hours; it then decreases with the same regularity, and is reduced to its constant day value, about 18 hours, i. e. at sunrise. The maximum value at night, is about double of the constant day value.

The function whose values have been hitherto considered is independent of the *direction* of the disturbance. If however, we take the sum of the squares of the easterly and westerly deviations separately, it is found that the easterly disturbance preponderates during the night, and the westerly during the day, the former being much more considerable than the latter, and the difference reaching a maximum about 10 hours. It thus appears, that the tendency to disturbance observes a *regular period,* both in magnitude and direction, connected with the diurnal movement. In order to perceive their relation to the *regular* diurnal variations, it will be necessary to regard the latter in a somewhat different point of view from that in which they have been usually considered. From the very small amount of the regular change of declination, which takes place during the night, and from the manifest connection of the day movement with the position of the sun, Dr. Lloyd said, that he was led to consider the position of the magnet during the night as its *normal* position, from which it was made to deviate during the day by the influence of the sun. In this point of view, the regular diurnal progression may be described, in its main features, as a westerly deviation of the north end of the magnet, commencing about an hour after sunrise, reaching its maximum a little after 1 P.M., and thence diminishing until a few hours after sunset, when the magnet returns nearly to its normal position. Now the *mean disturbance,* it will be remarked, observes a period nearly the reverse of this, both in magnitude and direction; its value being nearly constant during the day, while it is largely developed during the night,

in a direction opposed to that of the *regular* day movement. From these remarkable relations, which hold also between the changes, regular and irregular, of the horizontal intensity, it seems evident that the two classes of phenomena are *physically connected.* Without entering into the question of the mode of this connection, Dr. Lloyd said that he regarded the disturbance of the two elements (in part at least) as an *irregular re-action* from the regular day movement, and dependent upon it both for its periodical character and for its amount. If this hypothesis be a just one, it will of course follow that the magnitude of the mean disturbance will vary, in some direct proportion to the *daily range*, and should, therefore, be greater in summer than in winter. Now this (which is contrary to the results deduced by Prof. Kreil and Col. Sabine, with reference to the frequency of disturbances, extending a certain limit) appears to be the fact. If we calculate the mean disturbance of the declination for the several quarters of the year, we find it to be as follows—

Spring.	Summer.	Autumn.	Winter.
2′·66	3′·02	2′·52	1′·80.

From these results, it appears that the mean disturbance observes an *annual* as well as diurnal period; its *maximum* occurring in summer, its *minimum* in winter, while in spring and autumn its values are nearly equal. This important relation appears to confirm, in a remarkable manner, the views above given. It by no means necessarily follows, from the results above stated, that the periodical character necessarily belongs to *all* disturbances. It may be that there are *two classes* of disturbances, the results of distinct physical causes, of which one observes a period, while the other is wholly irregular; for it is obvious that on such an hypothesis, the period of the former would necessarily be impressed upon the resultant disturbance, and that the latter would have no effect in effacing it, provided the observations from which it was inferred were sufficiently numerous. There are many circumstances which seem to render this supposition highly probable, and if it be established, the next step in the investigation will be to distinguish these two kinds of disturbances by their external characters, and to resolve the complex resultant, where they happen to be combined into its more simple elements. Dr. Lloyd stated that he had commenced a series of observations in Dublin,

upon a plan which seemed likely to conduct to the solution of this problem—a problem which must be solved, before we can ascend with certainty to the physical causes of the phenomena.

'On a New Polarity of Light, with an Examination of Mr. Airy's Explanation of it on the Undulatory Theory,' by Sir D. Brewster.—Notwithstanding the great power of the Undulatory Theory in explaining phenomena, and its occasional success in predicting them, I have never been able to consider it as a representation of that interesting assemblage of facts which constitute Physical Optics. When a theory of high pretensions, and remarkable for its powers of accommodation is found incapable of explaining *whole classes* of well-observed and distinctly marked phenomena, those who have discovered or studied these phenomena may be excused for withholding from it their assent, and for not wholly abandoning older, though less popular views, which were sanctioned by such authorities as those of Newton and Laplace. It has fallen to my lot to lay before the public several of the facts to which I refer; but as it is not the object of this notice to discuss the general merits of the Undulatory Theory, I shall mention only *two* of those classes of facts which the Undulatory Theory has failed to explain. The first of these, which was communicated to the Royal Society about fifteen years ago, embraces the phenomena of *transverse fringes* which cross the fringes produced by grooved surfaces, and produce, both in common and homogeneous light, a series of phenomena equally beautiful and singular. In these phenomena we witness the extraordinary fact, that a stripe of polished metal is incapable, at various angles of incidence, of reflecting a single ray of homogeneous light; while, at intermediate angles of incidence, it reflects that light freely. The Undulatory Theory has never ventured to explain these phenomena, and I feel confident that they are beyond its power; and hence the phenomena themselves have excited no notice, and have shared the fate of all such intractable notions as repose submissive to the prevailing theory of the day. The second group of phenomena which the Undulatory Theory is equally incapable of explaining, present themselves in looking at a perfect solar spectrum, or a diffractive spectrum, through the edge of a thin plate of *glass*, *quartz*, or *mica*. If we cover one-half of the pupil of the eye with such a plate, and thus view the

spectrum so that the rays which pass by the edge of the plate may interfere with those which pass through it, then if the plate is on the same side as the *violet space*, the spectrum is seen crossed with numerous black and nearly equidistant bands, parallel to Fraunhofer's fixed lines, and, generally speaking, increasing with the thinness of the plate; but if the plate is on the same side as the *red space*, no bands whatever are seen, though all the other conditions of their production are the same. When the transparent plate is very thin the fringes of thin plates are produced, whether we cover the half or the whole of the pupil; but these have nothing to do with the phenomena under consideration. The singular fact of the fringes being seen only in one position of the plate appeared to me to indicate a *new polarity* in the simple elements of light. I therefore communicated it to the British Association at Liverpool, in 1836; and in 1837 I submitted to the same body additional observations, which excited some discussion. The singular phenomena contained in these notices, though pressed upon the attention of the supporters of the Undulatory Theory, remained unexplained for more than *three* years. They at last attracted the regard of Prof. Airy, in October, 1839, when that distinguished mathematician repeated my experiments; and in 1840 he made them the subject of an elaborate memoir, constituting the Bakerian Lecture of that year, entitled, 'On the Theoretical Explanation of an apparent New Polarity in Light.' (Sir D. Brewster read the parts of Prof. Airy's paper which could be readily understood by the section.) Previous to the publication of this ingenious paper, Prof. Airy gave an account of it at the meeting of the British Association in Glasgow, in 1839. On that occasion I made a few observations upon it; but especially marking the fact, that whereas Prof. Airy's explanation referred solely to very faint bands seen when the spectrum was *out of focus*, I had seen the bands perfectly distinct, and most vivid and intensely black, when the spectrum was *in focus*. The explanation, therefore, given in this memoir had nothing to do with the bands which I had discovered and described. Prof. Airy was accordingly led to resume the investigation; and he has published the results of it in a Supplement to his first paper, which appeared in the Philosophical Transactions for 1840. The following is the account which he gives of the results which he obtained:—

"In the Second Part," says Prof. Airy, "of the Transactions for 1840, the Royal Society has published a memoir by me, explaining on the Undulatory Theory of Light the apparent new polarity discovered by Sir D. Brewster, which explanation is based on the assumption that the spectrum is viewed out of focus; an assumption which corresponded to the circumstances of my own observations and to those of some other persons. Since the publication of that memoir, I have been assured by Sir D. Brewster that the phenomenon was most certainly observed with great distinctness, when the spectrum was viewed so accurately in focus that many of Fraunhofer's finer lines could be seen. This observation appeared to be contradictory to those of Mr. Talbot, cited by me in p. 226 of my memoir, as well as to my own. With the view of removing the obscurity that still appeared to embarrass this subject, I have continued the theoretical investigations for that case which was omitted in the former memoir,—namely, when the spectrum is viewed in focus, or when $a=o$ (p. 229;) and I have arrived at a result which appears completely to reconcile the seemingly conflicting statements."—Phil. Trans., 1841, p. 1.

Now, in the investigations which this paper contains, and which Prof. Airy considers satisfactory, there are two points which require special attention. The *first* of these is the assumption, necessary for the explanation, that even when any single point of the spectrum is seen accurately in focus, it forms a different image on the retina, the extent of the difference being exceedingly less than the interval between the bands. The supposition appears to me quite untenable, and one which cannot for a moment be admitted. The *second* point relates to the expression of $\frac{2\lambda\varepsilon,}{h}$ which Prof. Airy obtains for the interval between the bands; from which it follows, that this interval is inversely as the radius of the pupil, or the area of the object-glass. But the intervals *have no such rotation,* and Prof. Airy does not say that such a rotation was ever noticed in any of his experiments. I have made the experiment repeatedly and carefully, and can state with confidence, *that the fringes do not vary with the diameter of the pupil or the operations of the object-glass.* Their interval remains the same, whether we look through a pin-hole or with the pupil in its fullest expansion; and it is equally invariable when the

aperture of the object-glass is made to vary from a quarter of an inch to four inches. Hence it follows that the system of bands to which Mr. Airy's theory is applicable has no existence in nature; that the phenomena which I discovered are still unexplained by the Undulatory Theory, and may still be regarded as indicative of a new species of polarity, till they are brought under the dominion of some general principle. Since the publication of the two memoirs of Prof. Airy, I have devoted much time to the examination and measurement of the bands under consideration, and I have been led to the observation, of many new and complex phenomena. I am still, however, as ignorant as ever of the cause of the singular property to which this notice relates, though I have succeeded in tracing the phenomena to the true class of interferences to which they belong.

The Astronomer Royal observed that this communication had taken him by surprise. Until he saw the announcement in the journal of Sectional proceedings, about half an hour since, he was not aware that Sir D. Brewster contemplated entering on the subject. So imperfect was his memory on the subject, that he did not even remember that the formulæ read out by Sir D. Brewster were his. The Section must therefore see that, under these circumstances, he was totally unprepared to discuss the matter.—Sir D. Brewster stated that he had sent the title of this communication to the Secretary, in the prescribed manner, previous to the meeting, and he was under the impression that the Astronomer Royal was aware of his intention of calling the attention of the Section to the subject. He now regretted that it had not occurred to him to write to Prof. Airy on the subject.—Prof. Challis had entered upon an examination of this subject soon after the publication of Sir David Brewster's experiments; these he had repeated and verified in most points. He had, however, found that when he varied the inclination of the piece of retarding glass to the rays of light, the lines varied considerably.—Sir D. Brewster had examined the phenomena under every inclination of the piece of retarding glass, having varied it through all angles, both in a vertical direction and also horizontally, and had noted and described the effect produced upon these lines.—The Astronomer Royal admitted the difficulty of reducing such complex phenomena under the dominion of mathematical expression, but as far as the

lines under discussion were concerned, he had no doubt upon his own mind of the completeness of the explanation which he had given.—Prof. Powell had repeated Sir D. Brewster's experiments, and had found the facts to be rigorously as stated by him. He had also read with much care both papers of the Astronomer Royal on the subject, and expressed his conviction that the last one contained a complete explanation of the phenomena at that time described. It was obvious that cases might occur where the phenomena were complicated, and where some parts would depend for explanation on one principle, others on another, though observed together; but he did not think it fair, even supposing the phenomena remained still unexplained, to say that therefore they were incapable of being explained by the Undulatory Theory.

Sir D. Brewster next submitted a notice of Two New Properties of the Retina.—One of these properties related to the inferior sensibility of the retina at that part of it which corresponded to the *Foramen centrale* of Soemmering, and which opened itself only when the eyes were directed to a faintly illuminated surface. The other property of the retina appeared after the observer's eye had been impressed with the luminous stripes seen by looking out of a railway carriage in rapid motion, at the stones, or rather white bodies lying near the rails. When the eye is quickly shut under this impression, a motion is perceived in a direction transverse to the real impression on the retina; and there is the appearance of a complementary lens in the same transverse direction.

'On the Aberration of Light,' by the Rev. Prof. Challis.—The phenomenon of aberration was explained on the undulatory theory of light, by assuming the direction of vision to be always co-incident with the direction of propagation of the waves. A star, according to this supposition, is seen in its proper direction, while an object which moves with the spectator is seen in a direction which, with respect to the earth's motion, is *behind* its true place. Astronomical observation does not determine whether aberration affects the apparent position of the wire of the telescope, or of the star. Assuming the position of the star to be changed, it follows from this view, that the star must be considered to be *in advance* of its true place as regards the direction of the earth's motion, and this result is in accordance with

the principle on which corrections for aberration are applied in astronomical calculations.

'On the Aberration of Light,' by Mr. G. G. Stokes.—Mr. Stokes supposes that the luminiferous ether is displaced by the motion of the earth and planets through it, in a manner similar to that in which ordinary fluids are displaced by solids moving through them, though not necessarily according to the same laws. He supposes that the ether close to the surface of the earth is at rest relatively to that surface, being entangled in the earth's atmosphere. Consequently experiments on reflexion, refraction, and interference, made with the light coming from any particular star, will lead to the same result, at whatever time of year they are made, conformably with experiment. He supposes that light is propagated through the ether in motion, in the same way that sound is propagated through air in motion; that is to say, he supposes that the displacement of a small portion of a wave's front in a very short time is compounded of the displacement which would exist if the ether were at rest, and of the displacement of the ether itself, so that in general the direction of a normal to that portion of the wave's front is changed by the motion of the ether.

'On the Elementary Laws of Statical Electricity,' by W. Thomson, B.A.—Of late years some eminent experimentalists, and especially Mr. Snow Harris and Mr. Faraday, have begun to doubt, to a certain extent, the truth of Coulomb's laws, and have entered upon the investigation of various phenomena which appeared to be incompatible with them. The principal subject of this paper was an attempt to show that almost all the results adduced in their memoirs, which refer to electricity in equilibrium, are necessary consequences of the mathematical theory, and that none are at variance with it.

'On the Nebula 25 Herschel, or 61 of Messier's Catalogue,' by the Earl of Rosse.—Lord Rosse exhibited to the Section what he called his working plan of this nebula, and explained his method. He first laid down, by an accurate scale, the great features of the nebula as seen in his smallest telescope, which, being mounted equatorially, enabled him to take accurate measurements; he then filled in the other parts, which could not be distinguished in that telescope, by the aid of the great telescope; but as the equatorial mounting of this latter was not yet complete, he could not lay these

smaller portions down with rigorous accuracy; yet as he had repeatedly gone over them, and verified them with much care, though by estimation, he did not think the drawing would be found to need much future correction.

Sir J. Herschel said he could not explain to the Section the strong feelings and emotion with which he saw this old and familiar acquaintance in the very new dress in which the more powerful instrument of Lord Rosse had presented it. He then rapidly sketched on a sheet of paper the appearance under which he had been accustomed to see it, which was a nucleus surrounded by a ring-shaped nebulous light, with a nebulous curve stretching from one part of the ring to nearly the opposite. This had very strongly suggested to his mind what our system of stars, surrounded by the milky way, dividing into its two great branches, would appear if seen from a sufficient distance. But now this nebula is shown in such a way as greatly to modify, if not totally to change, former impressions. In the first place, under the examination of the more powerful instrument the nucleus became distinctly resolved into its constituent stars, which his telescope was not powerful enough to accomplish; and it now turned out that the appearance which he had taken for a second branch of the ring, was a nebulous offshoot, stretching from the principal nebula, and connecting it with a neighbouring much smaller one. This was to him quite a new feature in the history of nebulæ. The general appearance of the nebula, as now presented, strongly suggested the leading features of the shell of a snail rather than a ring. He felt a delight he could not express when he contemplated the achievements likely to be performed by this splendid telescope; and he felt no doubt that, by opening up new scenes of the grandeur of creation, it would tend to elevate and ennoble our conceptions of the great and beneficent Architect; the raising of our thoughts to Whom should be the aim of all our researches, as the advancing of our knowledge of Him, and the grateful tracing of the benefits and blessings with which He had surrounded us, was the noblest aim of all that deserved the name of Science.

'On the Heat of the Solar Spots,' by Prof. Henry, of Princeton College, New Jersey.—Sir D. Brewster read an extract of a letter which he had just received from Prof. Henry, who had recently been

engaged in a series of experiments on the heat of the sun, as observed by means of a thermo-electrical apparatus applied to an image of the luminary thrown on a screen from a telescope in a dark room. He found that the solar spots were perceptibly colder than the surrounding light surface. Prof. Henry also converted the same apparatus into a telescope, by placing the thermo-pile in room of the eye-glass of a reflecting telescope. The heat of the smallest cloud on the verge of the horizon was instantaneously perceptible, and that of a breeze four or five miles off could also be readily perceived.

'On Fog-rings observed in America,' by Sir D. Brewster.—This paper had been communicated to Sir D. Brewster by Sir John P. Boileau, respecting a fog bow which had been seen in January, 1808, by Sir George Rose, when off the Montgomery Reach, in the Potomac, in Virginia. Early in the morning a milk-white fog came on, so thick that the captain of the packet found it necessary to anchor, not knowing where he was. About half-past eleven he came up to Sir George, and remarked that they should have all clear soon, "for the fog-eater was come." The captain explained himself by pointing to the head of the vessel, where there was visible a ring of thicker white fog than that in which they were enveloped, apparently about 60 feet in diameter, the belt of the ring appearing about 2 feet broad. Within this ring was another, 2 feet in diameter, suspended in its centre, and with prismatic colours. It lasted about 20′ or 30′, when the fog cleared away. There was a severe frost on the following day.

'On a System of Numerical Notation,' by Mr. T. W. Hill.—This was proposed to be founded upon the number 16, and those derived from it by successive division by 2,—such as 8, 4, 2, 1. By the combinations of these all numbers were to be formed, and by attaching letters as the marks or names for the elementary numbers, a system of nomenclature was obtained which seemed grotesque and cumbrous in the earlier numbers, but which the author maintained became less complicated in the large and ordinarily less manageable numbers.

Saturday.

Section D.—ZOOLOGY AND BOTANY.

Dr. Carpenter read his Report 'On the Microscopic Structure of Shells.'

Mr. Busk referred to some drawings of sections of the cellular structure of shells, in which some of the cells were perfectly black. This was at one time supposed to arise from the presence of air, and other causes; but he believed that it depended on the form of the cell, which acted like a plano-convex lens; the consequence was, that the rays of light were so much refracted as to be lost. When a section of this structure was looked at obliquely, the black spots entirely disappeared.—Prof. E. Forbes remarked on the value of the microscope in every department of Natural History. With regard to the tubes in the structure of the shell of Terebratulæ, they were formerly supposed to be connected with the respiratory system; but as Dr. Carpenter had shown that that was not the case, he did not think those tubes could be any longer regarded of generic value.

'On the Sounds produced by one of the Notonectidæ under Water,' by Mr. Ball.—He stated, that the fact having been mentioned to him some two years since, he had not had an opportunity of testing the observation until within the last few days, when a specimen was brought to him in an ordinary jelly glass; it was, he believed, the *Corrixa affinis*. When suspended in the water, about four inches below the surface, it emitted three short chirrups, and then a long, cricket-like sound. It appears, the sounds are emitted in the evening and night, and are so loud that they may be heard in an adjoining room, and are continued during the night. Mr. Ball stated, that time did not permit him to make any accurate observation; but he thought the matter so curious, that he noticed it with the view of attracting the attention of entomologists, in the hope of obtaining an explanation of the manner in which this noise is produced under water.

'On the Scientific Principles on which Classification in the higher Departments of Zoology should be based,' by Mr. Ogilby.—The dental system was, no doubt, a valuable means of diagnosis, and this depended upon the fact that it had a relation to the stomach, and other viscera intended for the digestion of food. Just in the same way, the extremities of the mammalia, more particularly the fore-arm, are the exponents of the habits, mental power, and economy of animals. The fore-arm is the seat of the function of locomotion, of manipulation and touch. According to the real position of an animal in the scale of organization will be the character of its fore-arm. The

position was illustrated by examples from the various families of mammalia. He thought, that in our usual systems of zoology, a too exclusive regard had been given to the structure and form of the teeth.

Prof. E. Forbes read a 'Notice of Additions to the Marine Fauna discovered by Mr. R. M'Andrew since the last meeting of the Association.'—He also read the Report of the Dredging Committee. This Report consisted of a tabulated list of depths at which above ninety species of marine animals, chiefly the later British Mollusca, Radiata, and Zoophytes, were taken by Mr. M'Andrew during a series of dredgings from the Scilly Isles to the Hebrides, since the last meeting.

A letter was read by the Secretary from Capt. Portlock, replying to the remarks made at York by Prof. E. Forbes on the results of his dredging at Corfu.—The account then read, he had not wished to be considered a complete Report, but as an indication of progress. In conclusion, Capt. Portlock stated, that, "in dredging, a conclusion from a very limited range of research is as dangerous as similar conclusions have been in geological inquiries. For example, a hasty deduction from the appearance of an animal at a particular depth of water is evidently imperfect, as the nature of the bottom and the description of the marine vegetation are more likely to modify such appearances. I see, for example, that Prof. Bell quotes the discovery of *Eurynome aspera* by Prof. Forbes in the deep water of the Egean as a proof that the species is essentially a deep water one, both in the Mediterranean and the Northern Seas. Here, however, I have found it just at the verge of the rocks, where sea-weeds prevail, and therefore in comparatively shallow waters—*i. e.* from ten to sixteen fathoms. Other northern species, such as *Ebalia Pennantii, Achæus Crouchii,* (if I am right in my identification of them,) I have found under similar circumstances; and I am, therefore, the more inclined to ascribe their existence to the local peculiarities of vegetation than to the depth."

Prof. E. Forbes stated, in reply, that he had remarked at the last meeting that Capt. Portlock's Report was not drawn up according to the forms of the Dredging Committee; and that he had described, for want of books, as new, genera and species which were known.—Prof. Ansted commented on the importance of the contributions of

Mr. M'Andrew to the Fauna of the British seas, as they bore so decidedly on geological subjects. These discoveries proved the correctness of the general fact, that the range of a species in time was equivalent to its range in space.—Prof. Forbes exhibited a specimen of a Medusa, caught by Mr. M'Andrew, and preserved in Goadby's solution, and pointed out the importance of this means of preserving those soft animals. We know less of the Medusæ than any family of animals, and it arose from the difficulty of preserving them.—Prof. Allman pointed out the fact of the finding phytophagous Mollusca at depths in which no vegetable existed, but in which the Nullipora was found, in evidence of the vegetable nature of that class of beings.—Dr. Carpenter said, that he had examined the tissues of the Nullipores, and found them to be purely of a vegetable nature.

Mr. W. Thompson read a letter from Mr. Alder, dated Salcombe, June 17, 1845, in which the writer stated that he had lately obtained in Torbay at least ten, and perhaps twelve new species of *Mollusca nudibranchiata,* to add to the British Fauna. They consist of four species of Doris, five or six of Eolis, and an animal of an entirely new genus, approaching nearest to Tritonia. A singular species of mollusk obtained at the same time, resembling in general appearance the genus Pelta of Quatrefages, was noticed in detail.

'On the Discovery of Guano in the Faroe Islands,' by the Rev. W. C. Trevelyan.—This guano occurs principally on the shelves commonly from 8 to 20 feet wide, which are formed by the disintegration of the softer beds in the lofty precipices, often rising to the height of more than 1,000, and in one instance above 2,000 feet. Of such places, sheltered by the projecting rocks above, the sea fowl take advantage, and considerable deposits of guano are found there, often the collection of many years; though in some instances, when it accumulated so much as, from its slope towards the sea, to make an insecure resting place for the eggs, the Faroese, who did not know its value, but to whom the birds, both on account of their feathers and for food, were of great importance, shovelled it off into the sea. Now, however, they have learnt at least its commercial worth, and collect it carefully;—in many places at considerable risk, the collectors being let down by ropes to the ledges, whence they lower the guano into boats below.

'On Fizeau's Process of Etching Daguerréotype Plates, and its Application to Objects of Natural History,' by Mr. Goadby.—In a Daguerréotype portrait, the black parts of the plate consist of silver, the white of mercury, and the intermediate tint of a mixture of the two, the degree of darkness or light depending upon the excess either of the silver or of the mercury. In converting a Daguerréotype into an engraved plate, it is necessary to etch away the dark parts and to leave the white untouched. This is done by immersing the plate in a fluid, consisting of dilute nitric acid, nitrous acid, chloride of sodium, and nitrate of potash. The nitric acid is so far diluted, that no decomposition can take place until the mixture is heated, when the chloride of sodium and nitrate of potash are decomposed, and chlorine and nitrous acid are evolved. These attack and remove the silver, or the *dark* portions of the plate, but have no effect on the mercury, so that the *lights* of the picture, being the mercurialized portions of the plate, constitute the *etching* ground, and effectually defend such portions of the Daguerréotype from the influence of the corroding fluid. After a time, those portions of the plate that have been acted upon by the chlorine, &c. become covered with a protecting coat of the chloride of silver: this must be removed by dilute liquid ammonia, when the biting may be continued by a fresh supply of the mixed acid. Grease and foreign matter must be removed by repeated washings in dilute acid and alkali, and by boiling in caustic potash. These cleansing operations must be repeated after every biting, after washing out the chloride of silver by the ammonia. The plate being thus bitten, but in a slight degree, is to be inked after the ordinary manner of engravers, and allowed to dry; the surface of the plate is then to be thoroughly polished, the ink still remaining in the corroded portions of the plate. It is now to be gilded by the electrotype, those parts alone receiving the gold that have been previously polished. The ink is then to be dissolved out of the hollows by potash: the parts that are gilded now constitute the etching ground, instead of the mercury, and the biting may be henceforth continued by nitric acid, in the customary usage of engravers. The plate thus etched generally requires to be finished by the hand of the engraver, who has the advantage of a *perfect*, although *faint* picture to work upon. The amount of labour which he must bestow will de-

pend upon the goodness of the Daguerréotype, and the success of the etching. M. Claudet has fully established the successful application of this process to the purposes of illustrating Natural History, by copying from Nature and engraving several delicate and difficult dissections of the lower animals, particularly the nervous system of Aplysia and Tritonia (the latter much magnified), and the nutrimental organs *in situ* of a caterpillar. These preparations, together with the engravings of them, were handed round.

Dr. Carpenter stated, that a similar process had been employed for engraving microscopic objects, the discovery of which was due to Capt. Ibbetson. He exhibited some plates of blood-globules, and other microscopic objects published by Dr. Donné, of Paris, which had been procured in this way.

Sub-Section D.—ETHNOLOGY.

'On the Ethnography of the Indo-Chinese Nation,' by R. G. Latham.—There was no tract of country, the author remarked, of equal circumference, where the language was spoken with so much uniformity as in China. He described the characteristic of the languages of China, Thibet, and the ultra-Gangetic peninsula to be monosyllabic; these differed from each other to a greater or less extent, but they all had the monosyllabic characteristic. Another mass of languages was the Malay and Polynesian: from the Malayan peninsula northward and westward—from Sumatra, from Borneo, northward and westward, in the Philippine islands, along the whole north coast of New Guinea, in the Ladrones and Caroline Islands, in hundreds of mere specks in the sea, until we came to a small island half way to America, there was one mass of languages, with the exception of New Holland and Van Diemen's Land. He was satisfied the Malay language was of monosyllabic basis; and hence he contended for an affinity between it and the Chinese. Between the languages of Turkey, Siberia, Finland, Nova Zembla, &c. and that of China he could trace little affinity; but after the Malay, the language of the Caucasus had the closest affinity with that of China.

'On the Migratory Tribes of Central India,' by Mr. E. Balfour.—It has not been ascertained how many wandering tribes there are: the author confined himself to the description of the manners and

habits of seven. Although in many respects they are similar to each other, still there are differences which have interest in an ethnological point of view.

Dr. King exhibited a drawing of a specimen of gold casting as illustrative of the state of art of the inhabitants of New Grenada prior to the conquest. It represented the human figure sitting. The original was of fine gold, and weighed 1 oz. 18 dwts. 18 grs.

Section E.—MEDICAL SCIENCE.

Our readers are aware, from the Report of the Council, that it had been, by a resolution of the General Committee, referred to the Council to consider the propriety of so modifying the title and regulations of this Section, that it might include a more general range of subjects; also of the proceedings thereon taken by the Council. On Tuesday, at the close of the Sectional proceedings, Dr. Haviland, the President, informed the members present that the Council referred the subject back to the Committee of the Section, requesting a report thereon during the present meeting; that after an anxious consideration, and with the assistance of a large committee, formed especially for this purpose, the following resolutions had been passed:—" That the Committee of Section E. of the British Association are fully convinced of the utility and importance of the Section, and that it be recommended by the Committee that the title of the Section be changed to that of ' Physiology.' "—It was further resolved, " That the foregoing resolution, when presented to the General Committee, be accompanied by a brief statement of the reasons which led to the recommendation."—These resolutions had been placed in the hands of Prof. Phillips, accompanied by the brief statement alluded to, for presentation to the General Committee. Dr. Haviland concluded by stating that the object desired to be effected by the change proposed was the introduction into the Section of all those papers which elucidated life under all its conditions, normal and abnormal, whether by the aid of chemistry, anatomy, statistical inquiry, or pathological research. In order that this should be the result at future meetings, he requested the assistance and co-operation of all the members who were anxious that the proceedings of this Section should sustain the dignity of the profession and the character of the Association.

This Section did not meet till Saturday.

Mr. Sibson presented an apparatus for delineating correctly the relative position and size of the viscera, either in their healthy condition or changed by disease. It consisted of a square frame, covered by transparent lace or muslin, which will permanently bear chalk marks. By taking the outlines of the objects to be sketched (deformities, well marked conditions of thoracic or abdominal viscera, &c.) on the surface looking perpendicularly at the object, a correct outline is easily produced even by those who are not artists ; this sketch can be readily transferred to paper by pressure, and if necessary may be reduced by the application of the pentagraph. Mr. Sibson gave an illustration of its use by making sketches from the living body, and entered into numerous pathological details to show the importance of frequent delineation, to ascertain the progress of internal and external disease during treatment.

Dr. Brooke suggested an improvement to the apparatus by attaching to the frame a pencil moving parallel to itself and perpendicular to the plane, by means of jointed rods, as in the sockets sometimes adapted to a reading chair.

Dr. Macdonald read a paper 'On Cranial Vertebræ.'—The author commenced by enforcing the value and necessity of the study of what had been termed Transcendental Anatomy. After alluding to the labours of the foreign and British investigators of the subject, Dr. Macdonald laid down the elementary parts forming a vertebra, which he stated to be *first*, a body, forming part of the *caulis centralis* of the vertebral column ; *second*, the posterior laminæ, which meeting on the mesial plane form the arch of the vertebral canal, having the spinous processes more or less developed : each lamina is again subdivided into three elementary divisions, which he denominates protomeral, deutomeral, and tritomeral ; besides these there are, *third*, anterior laminæ connected with the *caulis centralis*, exemplified in the ribs and part of the pelvis, and also in the bones of the face. Retaining these divisions of each vertebra, the author described the cranial vertebræ, as three pairs arising from the spine : first, the occipital ; second, the sphenoidal ; third, the ingrassio-ethmo-frontal ; by attentively examining the component laminæ of these vertebræ, he identified all the usually described portions of the cranium. The facial bones he resolved into two pairs of vertebræ : first, the super-

ciliary; second, the adnasal. By a minute demonstration the author endeavoured to establish the details of his system, which he contended was applicable to all the zoological classes and as well marked in the insect tribe as in the mammalia.

Dr. Brooke presented an instrument to assist in the discovery of foreign bodies by auscultation. It consisted of a catheter or sound, with a circular sounding-board, six inches in diameter, attached perpendicularly at its extremity, which increases the sensation derived from the contact of its other end against a small calculus or fragment after lithotripsy, which might otherwise escape detection, and lay the foundation of future disease. The effect of the sounding-board was demonstrated. A sound produced by the contact of a small fragment in a small bag, which could scarcely be heard by the holder of the instrument without the sounding-board, became perfectly audible on its application.

Section F.—STATISTICS.

Mr. Fletcher read a statistical and historical account of the ancient system of public charities in London. He stated that the necessity of systematic provision for the relief of the poor began to be felt after the suppression of the monasteries and the hospitals governed by monastic rule. In 1544 the site of St. Bartholomew was granted to the Corporation of London, but no provision was made for its endowment and government until 1548; and thus some provision was made for the relief of the sick and infirm. Christ's Hospital, for the education of destitute children, was founded in 1553, and about the same time St. Thomas' Hospital was established for the same purpose as that of St. Bartholomew. The next measure was to provide a place for vagrants and unemployed labourers. The petition sent by the Corporation to the King's Council stated, "it was too evident to all men that beggary and thievery did abound, and we, remembering how many statutes from time to time have been made for the redress of the same, and little amendment hath hitherto followed, thought to search the cause hereof, and after due examination had we evidently perceived that the cause of all this misery and

beggary was idleness; and the means and remedy to cure the same must be its contrary, which is labour; and it hath been a speech used of all men to say unto the idle, Work! Work! even as though they would have said, the mean to reform beggary is to fall to work." In consequence of this petition Bridewell was established, and thus public charity was organized for three great objects—the relief of the sick, the education of the young, and the employment of the able-bodied labourer. The hospitals were supported by assessments levied on the citizens and the companies. By the charter of Edward the Sixth the government of these institutions was given to the Corporation of the City of London, but the chief power was seized by the Court of Aldermen. Mr. Fletcher then explained the causes that placed these institutions in the hands of self-elect governors, between whom and the corporation a kind of compromise was effected by Act of Parliament in 1782. But this Act only provides for the election of forty-eight governors annually by the Common Council, twelve for each hospital, Bethlehem being reckoned with Bridewell; and as these form but a small minority among the total number of governors, the anomalous self-elect constitution of these bodies continues to the present day. Mr. Fletcher then entered into an elaborate detail of the various efforts that have been made to suppress mendicancy by penal enactments, some of which were so severe as to vest an arbitrary power of transportation in any two governors of Bridewell. In 1708 the London Workhouse, though of earlier origin, was first brought into full operation; but it fell into a state of inefficiency and was abolished. Mr. Fletcher then contrasted the system of relief attempted by the Royal or Corporation Hospitals with the present pauper administration of London, and showed how widely the hospitals had deviated in practice from the principles at which their founders aimed.

Prof. Pryme said that too much importance had been attributed to the suppression of monasteries as a cause of pauperism. Before that time repeated Acts of Parliament had been passed complaining of the increase of vagrancy and mendicancy. The influx of the precious metals from America had lowered the value of money, and as there was no corresponding increase in the rate of wages, the condition of

the labourer had been much deteriorated. This was further shown by the fact, that similar complaints of the increase of vagrancy and beggary were made in Spain and Belgium, where the monasteries were not suppressed at the same time as in England, and a similar course of legislation adopted. He was also of opinion that the breaking up of the feudal system, in the reign of Henry the Seventh, had at the first, though not subsequently, an injurious effect on the condition of the labouring classes.

Sir John Boileau then read a brief abstract of the result of inquiries into the state of the agricultural labourers in the county of Norfolk. Out of 680 parishes to which queries had been addressed, 426 sent returns. These parishes contain 664,487 acres, of which 471,399 are arable. The total number of labourers usually employed thereon is 23,058 labourers, of which 18,277 are above 20 years of age, and 4,781 above 14 and under 20 years of age. Hence the average of labourers of all kinds to land of all kinds is $3\frac{1}{2}$ to 100 acres. The average of labourers of all kinds to arable land is nearly 5 to 100 acres. Labourers above 20 to 100 acres of all kinds $2\frac{5}{6}$ to 100 acres. Labourers above 20 years of age to arable land is $3\frac{5}{6}$ to 100 acres. Hence it was concluded that there was no surplus supply of labour in the country, and that the land, if judiciously cultivated, would provide employment for the entire population.

Mr. Nield then presented a series of elaborate tables, forming the Statistical Returns of the Police of Manchester in the year 1844, with the observations of Mr. Willis, Chief Constable. The total number of apprehensions from the 1st of January to the 31st of December 1844 has amounted to 10,702, being a considerable decrease in the number apprehended, as compared with previous years, and exhibiting much fewer apprehensions during the past year than during any year since the establishment of a day and night police force. The decrease may be, in some measure, attributed to the more prosperous state of trade, which, as compared with previous years, has existed during the period to which the present returns relate. At the same time, as it is a fact well known to the police, that there are always a large class of persons who never work,

and another class who (although employed, and in the receipt of good wages) are in the habit of committing, or attempting to commit, felonies after their hours of labour; there can be no doubt that the decrease in the number of apprehensions is not to be altogether attributed to the state of trade, but must be partly ascribed to the increased efficiency of the police, which has tended in a great measure to prevent the commission of crime. As respects the summary convictions in the year 1843, out of 12,147 apprehensions, there were 2,981 summary convictions and 758 committals for trial; whilst in 1844, out of 10,702 apprehensions there were 3,961 summary convictions and 691 committals for trial; or an actual increase in the past year of nearly 1,000 convictions, although the number of apprehensions has been less by 1,445 individuals. The increase in the number of summary convictions may, in a measure, be attributed to the provisions contained in the New Police Act, which came into operation on the 4th of July 1844, which enables the Justices to punish by fine or imprisonment parties found drunk in the streets, and which power has been frequently exercised. The number of apprehensions for drunkenness is 4,156, (being 42 less than in the previous year,) and from the persons of this class the sum of 1,392*l.* 10*s.* 10*d.* has been taken and restored when discharged. The return also shows, that out of a gross amount of 7,658*l.* 6*s.* 11*d.* reported to have been stolen during the year, the sum of 3,040*l.* 14*s.* 3*d.* has been recovered by the police; and that out of a sum amounting to 1,801*l.* 8*s.* 1*d.* reported to have been accidentally lost, the police have been instrumental in recovering 1,126*l.* 6*s.* 3*d.* The only other table which it may be necessary to notice is that which shows that during the past year 2,798 premises have been found open and insecure by the police during the night; of this number, 1,433 consisted of warehouses and shops, containing property, in which no parties resided, or were left in charge; 649 of houses, shops, and warehouses, containing property, and in which parties did reside; and 538 of empty houses. The same table also shows that the police have, during the past year, restored to their friends 2,637 children found apparently lost in the streets.

Section G.—MECHANICAL SCIENCE.

So many distinguished engineers were detained in London, in attendance on committees of the House of Commons, that this Section met on Thursday and Friday only to adjourn. Other members, who had run down for a day or two, were obliged to return; and so few were in attendance when the Section met on Saturday for business, that it was thought best merely to read the few papers received, and then close the Section. In reference to this subject, we have received the following letter :—

You will oblige me by stating, that I was prepared to lay some remarks before Section G 'On the experimental determination of the Strength of Wood and Cast-Iron,' but the attendance was so small owing to the immense quantity of business keeping those who are interested in engineering in London, and had been so small all the week from that reason, that Prof. Willis advised me to reserve my paper, and on this suggestion I acted. If you will state this, or something to this effect, you will oblige yours, &c.

M. Cowie,

Principal of the College of Engineers, Putney, Surrey.

The first paper read was, 'On a new method of converting Rectilinear into Rotatory Motion,' by Dr. Booth.—The object of the communication was to show the applicability of a new species of crank, termed by the inventor the *sliding crank*, to the steam engine, more especially in those cases where space is an object of primary consideration. One of the most important improvements effected by this motion is, that the distance between the shaft and the top of the cylinder is only one-half the length of the stroke. Other advantages pointed out in the course of the paper were, that the friction on the sliding parts is nearly insensible; that almost all the parts of the engine have a rotatory instead of a reciprocating motion: that all the subsidiary parts of a low-pressure engine are worked with great simplicity; and that in this construction, a longer stroke than in any other of the same dimensions may be introduced, and the expansive principle more fully developed.

Mr. J. Taylor made a few remarks, and observed that the effect of friction on the action of slides, seemed to be in general much overrated.—Mr. Fairbairn observed, that the invention, if carried into successful operation, seemed adapted to work an improvement in marine engines especially, where room was a matter of great importance, by lowering the position of the machinery, which appeared a great desideratum at the present day. He objected, however, to the difficulty of obtaining easy access to some parts of the machinery; the raising of the piston cover, for example, on this construction, would be a laborious operation. After some further remarks,—

Dr. Greene followed, with a description of Mr. Nasmyth's Steam Hammer for Pile Driving. This machine has been described at former meetings of the Association. Dr. Greene now read a letter received from Mr. Nasmyth, dated Devonport, in which it was stated that at the first trial with a part of the machine at the manufactory it drove a pile 14 inches square, and 18 feet in length, 15 feet into the ground with 20 blows of the monkey, the machine then working 70 strokes a minute; the ground was a coarse ground imbedded in a strong tenacious clay, performing this work in 17 seconds. The entire machine is now in full action at Devonport for the embankment to be erected there to keep out the sea, and form a wet dock. He describes it as going far beyond what he had dared even to hope for, and that it is truly laughable to see it stick vast 66-feet piles into the ground as a lady would stick pins into her pincushion. The entire of the operations required to be performed on each pile from the time it is floated alongside of the stage until it is embedded in the solid foundation of slate rock is only 4½ minutes. The great stage which carries the machine, boiler, workmen, and every thing necessary, trots along on its railway like a wheel-barrow and moves on, the diameter of a pile, the moment it has finished the last. It picks the pile up out of the water, hoists it high in the air, drops it into its exact place, then covers it with the great magic cap, which follows it as it sinks into the ground, then thump goes the monkey on its head, jumping away 70 jumps a minute. At the first stroke the pile sank 6 feet, its advance gradually diminishing until in the hard

ground above the solid slate rock it was reduced to 9 inches. Nothing can better prove the superiority of the principle of this invention, of getting the momentum by a heavy weight moving with small velocity over the same momentum, as got, on the old principle, by a light weight moving with great velocity, than the state of the heads of the piles as driven by each process. Dr. Greene drew attention to a sketch of two heads of piles, one 56 feet long driven by a monkey of 12 cwt., falling from a great height, and making only one blow in five minutes, and requiring 20 hours to drive it; this, though protected by a hoop of iron, is so split and shattered on the head, that it would require to be re-headed to drive it any further. The other, although 66 feet long, was not even supported by an iron hoop, and the head is as smooth as if it were dressed off with a new plane. It was driven with a hammer 50 cwt. and only 3 feet fall, making 70 blows a minute.

Mr. Fairbairn read a communication on the subject of Railway Gradients,—the object of which was to show the importance of economizing the first cost of railways, by introducing steep gradients in difficult districts, whereby the expenses attendant on tunnels, viaducts, and lofty embankments, would be avoided; whilst the author showed that the desired speed might be obtained by increasing the power of the locomotive. Originally, cylinders only of 10-inch diameter had been used, but at the present time, the engines are furnished with cylinders of 14, 16, and 18 inches diameter. The *maximum* speed which had been originally calculated on, was 10 miles per hour, whereas, at the present time, the ordinary speed on the Great Western, with first-class gradients, is 40 miles. The paper was illustrated by many experiments which had recently been made with regard to gradients on the Manchester and Leeds Railway.

Mr. Whishaw confirmed these views by the results of practical experiments to the extent of nearly 4,000 miles, on nearly all the lines of British railways.—*From the Athenæum.*

Mortality of the Madras Army; from Official Records. By Lieut. Colonel Sykes, F.R.S.

Very vague,—indeed, mistaken ideas, obtaining in Europe with respect to the value of life in India, both European and Native, and more particularly so regarding the extent of the mortality arising from that, no doubt, appalling scourge, the Spasmodic Cholera, I have thought it desirable to record in the pages of our Journal* the following per centages of deaths, during five years in the Madras Army, a body of about 1,580 European Officers, 3,762 European soldiers, and 62,513 Native soldiers, exclusive of the Royal army, distinguishing Europeans from Natives, and the per centage deaths from all causes, from deaths when Cholera is excluded. It will be a consolation to those connected with India, on referring to these facts, to find that an exaggerated view is generally taken of the diminished value of life in India, and of the loss occasioned by Spasmodic Cholera.

	1840.	1841.	1842.	1843.	1844.
European Troops.					
Deaths from all causes ...	4·333	3·130	4·205	4.905	2·810
Deaths excluding those from Cholera	3·843	2·969	2·855	3·248	2·397
Native Troops.					
Deaths from all causes	1·136	1·460	2·634	2·371	1·994
Deaths excluding those from Cholera	0·965	1·126	1·600	1·144	1·284

It will thus be seen, that amongst the Europeans the deaths from Cholera were, in the respective years, only 0·490, 0·161, 1·350, 1·657, and 0·423 of the whole deaths; and amongst the Natives, 0·171, 0·334, 1·034, 1·227, and 0·710, of the whole deaths.

At a future period, I may supply a similar statement for the armies of Bengal and Bombay.

* Journal of the Asiatic Society.

THE

Calcutta Journal

OF

NATURAL HISTORY.

Synopsis of the Genera of Indian Compositæ, translated and abridged from DeCandolle's Prodromus—with a few additions and occasional Notes. By Robert Wight, M.D., F.L.S., *&c.*

INTRODUCTION.

[The following Synopsis was prepared as a supplement to the article Compositæ for my Illustrations of Indian Botany. Sometime after its completion, having a number of Compositous plants to name, I found it of much easier use and more convenient in practice, than the inestimable volumes from which it is extracted. This almost unlooked for result has induced me to send it for publication in the Calcutta Journal, in the hope—I had almost said conviction—that it will prove the means of saving Indian Botanists, engaged in the study of this vast and most difficult family, a good deal of labour and time, and occasionally probably, some vexatious uncertainty, in their attempts to determine the genus of an unknown Compositæ. If this hope and wish is fulfilled, my object is gained, as in that case our knowledge of the Indian division of a most disheartening family to study, will extend as the facilities for its study increase.

It will be seen by those who take the trouble to compare my characters with the originals, that I have generally departed consider-

ably from DeCandolle's arrangement. My object in doing so was to render them more compendious, the alteration in form better enabling me to retrench superfluities, and at the same time give greater precision, by placing the strongest points of each at the beginning. The characters taken from the capitula, flowers, achænia, and pappus—which are really the essential ones—occupy the first rank: while those taken from the vegetation generally, including the texture and duration of the stem, form, and position of the leaves, peculiarities of the inflorescence, the receptacle and its clothing, and the colour of the flowers, are uniformly referred to the second. By following this plan, the characters are in fact completely re-cast, and, though still made up of the original materials, are, I think, rendered of much more easy application in practice, and to that extent at least are improved.

According to DeCandolle's classification, the whole family is divided into three primary groups or sub-orders, viz. *Tubuliflore, Labiatifloræ,* and *Ligulifloræ.*

These are again divided into "eight tribes," each of which are still further divided into "sub-tribes" and "divisions."

The characters of the tribes and sub-tribes are admitted into this Synopsis, but only occasionally the lower divisions, the comparatively small number of genera not requiring the aid of so much subdivision to facilitate the working out of any genus.]

Notes on Indian Botany. By Robert Wight, M.D., F.L.S., *Member of the Imp. Acad. Nat. Curios. of the Royal Bot. Soc. of Ratisbon, &c. &c.*

* Tubuliflore. Hermaphrodite flowers tubular regular 5 (rarely 4) toothed. [In this division all sorts of flowers occur, hermaphrodite, female and male, possibly sometimes all in the same capitulum—two kinds very generally, female and hermaphrodite—the character is however limited to the hermaphrodite flowers.]

Tribe 1st. Vernoniaceæ. Style of the hermaphrodite flowers cylindrical, branches usually elongated, subulate,

rarely short and obtuse, always equally and longish hispid, (semper equaliter et longiuscule hispidis) : stigmatic series ending above the middle of the branches of the style. [Of this tribe D. C. defines 59 genera, 6 of which have Indian representatives.]

Tribe 2nd. EUPATORIACEÆ. Style of the hermaphrodite flowers cylindrical, branches long, somewhat thickened or clavate above, exteriorly puberulously papillose : stigmatic series scarcely elevated, usually ending above the middle of the branches of the style. [Genera 44, of which 2 only are found in India.]

Tribe 3rd. ASTEROIDEÆ. Style of the hermaphrodite flowers cylindrical, branches exteriorly somewhat flattened, equally and minutely puberulous above : stigmatic series prominent, extending almost to the origin of the exterior hairs. [To this tribe 172 genera belong, 31 of which have Indian species.]

Tribe 4th. SENECIONIDEÆ. Style of the hermaphrodite flowers cylindrical, branches linear penicillate at the apex; sometimes produced beyond the penicillus into a short cone, or elongated into a narrow hispid appendix : stigmatic series broadish and prominent, extending to the pencil. [This is by much the largest tribe of the family : it contains 388 genera, 36 of which have Indian representatives.]

Tribe 5th. CYNAREÆ. Style of the hermaphrodite flowers nodosely thickened above, often penicillate at the knot, branches sometimes cohering, sometimes free, puberulous exteriorly : stigmatic series not prominent, confluent, extending to the apices of the branches and there confluent. [To this tribe 81 genera are referred, 13 of which have Indian representatives.]

** Labiatifloræ. Hermaphrodite flowers, usually bilabiate.

Tribe 6th. Mutisiaceæ. Style of the hermaphrodite flowers cylindrical, or somewhat nodose above, branches usually obtuse or truncated, very convex, and clothed on the superior part with minute hairs, which are rarely wanting. [This tribe includes 54 genera, only 4 of which are referable to the Indian Flora.]

Tribe 7th. Nassauviaceæ. Style of the hermaphrodite flowers not nodosely thickened, branches linear longish, truncated at the apex or penicillate. [This tribe contains 26 genera, but has no Indian representative.]

*** Ligulifloræ. All the flowers hermaphrodite.

Tribe 8th. Cichoraceæ. Style cylindrical above, branches longish, somewhat obtuse, equally pubescently-roughish: stigmatic series ending above the middle of the branches of the style. [This last includes 83 genera, of which 11 have Indian species.]

The total number of genera are extracted from Meisner's 'Genera Plantarum,' as owing to some errors in the numbering of the series in D. C.'s Prodromus, they could not be so correctly obtained from that work. A few genera were omitted by D. C. which, when added to the above, make up the total number to about 920. Several have however been since added to that series, so that the total number now defined in Botanical works may perhaps amount to about 950. Some of these will probably require to be reduced, but others must be formed to include imperfectly known species, which are, for the present, referred to genera to which they seem most nearly related, but to which they may not properly belong.

Synopsis of the Genera of Indian COMPOSITÆ.

Tribe 1. VERNONIACEÆ.

Sub-tribe. VERNONIEÆ. *Capitula discoid homogamous.*

Div. I. EUVERNONIEÆ. *Anthers ecaudate, involucrum not compressed, polyphyllous.*

1. OIOSPERMUM, (Less. D. C. Prod. 5-11). Capitula many flowered, flowers equal: achænia rounded at the apex, 10-ribbed: pappus wanting. Herbaceous, diffuse opposite-leaved plants: capitula solitary, long peduncled opposite the leaves: involucrum spreading, terete, surrounded at the base by unequal-sized leaves, longer than the capitulum: receptacle naked, broad: corolla regular 5-cleft, pale.

2. ETHULIA, (Cass. D. C. 5-12). Capitula many flowered: achænia obpyramidal 4-sided, 4-ribbed, glabrous, glandular, truncated at the apex: pappus minute, entire, fleshy, crown-like. Erect ramous herbs; leaves alternate pellucid dotted: involucrum terete many series, scales subfoliacious: receptacle naked; corolla rose-coloured or purple.

3. VERNONIA, (Schreb. D. C. 5-15). Capitula usually many flowered: achænia with a cartilaginous callus at the base and a large epigynous disk: pappus usually a double series, the interior one bristly, much longer than the paleaceous outer one. Herbs, shrubs or trees; leaves alternate, often glandulose: involucrum imbricated, interior squamæ longest; receptacle naked, or rarely subfimbrillose: flowers few or many: corolla regular 5-cleft, usually purple or rose-coloured.

4. DECANEURUM, (D. C. 5-66). Capitula many flowered: achænia usually glabrous, marked with 10 prominent ribs: pappus 1-series, bristles thick, rigid, densely barbellate. Her-

baceous or suffruticose : leaves alternate : involucrum imbricated, often surrounded with foliacious bracts : receptacle flat, alveolate : flowers regular 5-cleft, purplish.

5. Monosis, (D. C. 5-77). Capitula 1-flowered : achænia glabrous terete : pappus 2-3-series, bristles rigid scabrous. Arboreous or suffruticose, leaves alternate : panicles naked, the apices of the branchlets bearing numerous subumbellate sessile capitulæ : scales of the involucrum imbricated, obtuse, shorter than the flowers : corolla rose-coloured. [M. Wightiana is a considerable tree, with large obovate leaves, traversed by thick transverse veins like those of a Dillenia.]

Div. II. Elephantopeæ. *Anthers ecaudate : involucrum compressed : scales alternately conduplicate.*

6. Elephantopus, (Cass. Lin. D. C. 5-85). Capitula of several (3-5, usually 4) equal flowers, densely congested into a glomerulus, enclosed by leaves : achænia slightly compressed, many ribbed, pilose : pappus 1-series, some of the bristles dilated at the base. Perennial pilose herbs : alternate, with leaves and terminal ; glomerulus involucrum compressed, scales in a double series, alternately flat and conduplicate : rachis naked : corolla palmate, limb 5-cleft, one of the fissures deeper.

Tribe II. Eupatoriaceæ.

Sub-tribe. Eupatorieæ. *Capitula homogamous.*

Div. II. Agerateæ. *Pappus paleaceous or partly squamellate.*

7. Ageratum, (Lin. D. C. 5-108). Capitula many flowered : achænia somewhat 5-angled, attenuated at the base : pappus 5-10, free paleaceous scales, aristato-acuminate, or

pectinate obtuse. Annual erect herbs, with opposite leaves: involucrum imbricated: receptacle naked: flowers blue or white.

8. ADENOSTEMMA, (Forst. D. C. 5-110). Capitula many flowered: achænia obovate oblong, surmounted by 3-5 rigid bristles, glandular globose or clavate at the apex. Herbs with opposite leaves and corymbosely panicled capitula: involucrum campanulate, somewhat shorter than the flowers: squamæ 1-series, foliacious, oblong: receptacle flat, naked, foviolate: corolla white; stigmas long exserted, thickened at the point and coloured.

Tribe III. ASTEROIDEÆ.

Sub-tribe I. ASTERINEÆ. *Capitula homo or heterogamous usually radiate. Anthers ecaudate, leaves almost always alternate.*

9. ASTER, (Nees. D. C. Prod. 5-226). Capitula radiate, flowers of the ray 1-series fertile; of the disk hermaphrodite, 5-toothed: achænia compressed: pappus pilose, persistent, several series: bristles scabrous, unequal, otherwise similar. Perennial herbs, with alternate leaves: capitula solitary or several, corymbose: scales of the involucrum several series, loosely imbricated: receptacle alveolate; margins of the alveolæ more or less dentate: flowers of the ray white, blue, or purplish; of the disk yellow. [This genus seems scarcely admissible into the Indian Flora.]

10. CALIMERIS, (Nees. D. C. 5-258). Capitula radiate, ray ligulate female, 1-series; disk hermaphrodite fertile: achænia compressed, rough on the margin: pappus about 1-series, rough, unequal. Herbaceous perennials, stems angled, corymbose: scales of the involucrum 2-4-series, herbaceous,

loosely imbricated: receptacle alveolate, alveolæ 4-angled, angles toothed; flowers of the ray white or blue, of the disk yellow.

11. Callistephus, (Cass. D. C. 5-274). Capitula many flowered; of the ray ligulate female; of the disk tubular hermaphrodite: achænia obovate cuniform compressed roughish: pappus double, each of 1-series; exterior short, paleaceously setaceous, cohering into a crown; interior long, filiform, rough, deciduous. Erect ramous, herbaceous, annuals; branches with a single capitulum on the apex: involucrum 3-4-series: scales ciliate obtuse, embraced by foliaceous bracts, shorter than the involucrum: receptacle slightly alveolate, flowers yellow.

12. Heterochœta, (D. C. 5-282). Capitula many flowered radiate: ligulæ female linear, several series; disk hermaphrodite: young achænia compressed? pappus double, exterior short paleaceous, interior long bristly rough. Pilosely villous whitish herbs: capitula solitary terminal: scales of the involucrum 2-3-series, equal, acuminate: receptacle naked, punctulate: flowers of the ray white or purplish.

13. Erigeron, (Lin. D. C. 5-283). Capitula many flowered radiate: ligulæ linear female several series; disk tubular, either all hermaphrodite or with the exterior florets female: achænia compressed, beakless: pappus 1-series. Herbaceous or suffruticose; leaves alternate: capitula hemispherical: involucrum 2-3-series: receptacle naked, foviolately punctate: flowers of the ray white, blue, or purple: disk yellow.

14. Stenactis, (Nees. D. C. 5-298.) Capitula many flowered; those of the ray 1-series female, narrow ligulate; of the disk hermaphrodite 5-toothed: achænia oblong compressed: pappus of the ray 1-series, setaceous, of the disk

double, the exterior short, interior like the pappus of the ray. Erect herbs with alternate leaves: capitula solitary on the apices of the branches: scales of the involucrum 2-3-series: receptacle naked, plain or convex: ray florets white, or pale-purple; disk yellow.

15. ASTEROMÆA, (Blume, D. C. 5-302). Capitula many flowered: ray 1-series female ligulate; disk hermaphrodite: stigmas of the disk lanceolate: achænia 4-ribbed, somewhat compressed, attenuated at the base, somewhat glandulose, hairy: pappus 1-series, united at the base, setaceously cleft at the apex. Erect glabrous herbs, with alternate leaves: capitula solitary on the apices of the branches, involucrum 2-series: scales herbaceous at the apex: ligulæ blue or white; disk yellow.

16. MYRIACTIS, (Less D.C. 5-308). Capitula heterogamous: flowers of the ray 2 or many series female; ligula very narrow; of the disk hermaphrodite: achænia compressed, beakless, often glanduliferous at the apex: pappus none. Erect dichotomously ramous herbs with alternate leaves: peduncles long, 1 cephalous, paniculate: capitula globose: involucrum 1-2 series: receptacle naked: florets white or yellow.

17. PSIADIA, (Jacq. D. C. 5-318). Capitula heterogamous, at first sight discoid, though truly radiate, ray florets several series very short; disk hermaphrodite or male by abortion, 5-toothed: achænia of the ray oblong, glabrous, beakless: pappus uniform 1-series. Shrubs with alternate petioled leaves and corymbose inflorescence: involucrum several series, imbricated: receptacle subalveolate.

18. MICROGLOSSA, (D. C. 5-320). Differs from the preceding in the disk florets which are 3-5-cleft, male. Suffruticose erect or somewhat voluble: leaves alternate: in-

florescence corymbose: pappus reddish. [I can see no satisfactory reason for separating this from the preceding.]

19. Amphirhapis, (D. C. 5-343). Capitula radiate: ligula 10-20 homochromous; (same colour as the disk) disk 5-toothed, hermaphrodite: achænia linear oblong, slightly compressed, villous or pubescent; the villi sometimes simulating an exterior pappus: pappus 1-series, setaceous, rigid. Perennial erect herbs, with alternate leaves and corymbose capitula: involucrum imbricated: receptacle alveolate: flowers all yellow.

Sub-tribe II. Baccharideæ. *Capitula heterogamous or dioicous, never radiate, all the florets tubular, usually several series of female ones in the circumference. Anthers ecaudate, receptacle epaleaceous. Leaves alternate.*

20. Blepharispermum, (Wight Herb. D. C. 5-368). Capitula 4-flowered, numerous, combined into a globose glomerulus: flowers tubular, 2 exterior female 3-toothed, 2 interior male 5-toothed: style not exserted, scarcely bifid: anthers apiculate, subcaudate at the base: achænia oboval-oblong, compressed, subtetragonous; two of the angles nerve-like glabrous, 2 marginal ciliate: pappus of the female flowers 3-5 palea; of the male none. Glabrous shrubs, leaves alternate; glomerules globose one or more on the ends of the branches: involucrum double, receptacle of the capitula narrow, with a palea between the flowers.

21. Athroisma, (D. C. 5-368). Capitula numerous, combined into an ovate glomerulus: axis of the glomerule cylindrical: capitula several flowered, heterogamous, 4-5 exterior flowers female slender 4-5-toothed; central ones few male, wider above, 5-toothed: achænia black, obcompressed oval,

plano-convex, the marginal angle ciliate near the apex: pappus sparing subsetose. Erect ramous herbs, suffruticose at the base: leaves alternate: receptacles of the capitula bearing numerous concave membranaceous palea among the flowers: involucrum few leaved, scarcely distinguishable from the palea of the receptacle.

22. Sphæranthus, capitula heterogamous several flowered densely aggregated into a globose glomerulus: flowers all tubular: females thickened at the base 3-dentate, several series in the circumference: males, by abortion of the style, in the centre 5-toothed: style in the centre florets undivided: achænia beakless, pilose: pappus none. Herbs, leaves decurrent, peduncles winged or wingless, one cephalous, glomerules dense: scales of the partial involucrum numerous, 2-3-series: partial receptacle naked, general bracteolate, flowers purple.

23. Oligolepis, (R. W. Calcutta Journal not Cassini). Capitula numerous heterogamous, about 5 flowered: flowers all tubular; females few (about 4) 1-series pedicelled slender 3-dentate in the circumference; hermaphrodite solitary in the centre sessile 5-toothed subcampanulate: style in the central flower undivided: achænia beakless, of the females terete hairy, of the disk obsoletely 4-sided glabrous: pappus none. Glabrous herbs with decurrent spathulate leaves, and dense ovate oblong axillary glomerules: involucra usually one scale to each flower, that of the hermaphrodite much larger, forming a common involucrum to the capitulum, aristato-mucronate; those of the females linear, truncated at the apex and adhering at the base to the pedicels: hermaphrodite corolla large subcampanulate, made up of a congeries of quadrangular cells very fragile under the knife. [The plant which forms the type of this genus is the *Sphæranthus amaran-*

thoides of Burman and D. C. but is amply distinct both in structure and habit from *Sphæranthus*.]

24. Dichrocephala, (D. C. 5-371). Capitula heterogamous, flowers all tubular; marginal ones female many series, 3-4-toothed, central hermaphrodite or male few, 4-toothed: achænia compressed beakless, of the females bald, of the hermaphrodite crowned with 1-2-bristles. Annuals with alternate leaves and small globose capitula, expanded involucra and conical naked receptacles: flowers purplish.

25. Grangea, (Adans, D. C. 5-372). Capitula heterogamous, florets all tubular; of the circumference two or several series female, very slender, 3-toothed; of the centre hermaphrodite, 5-toothed: style of the disk undivided: achænia obovate, somewhat compressed, attenuated at the base, crowned with an entire cup-shaped pappus, slightly fimbrillate on the margin. Procumbent herbs, leaves alternate, sinuately pinnatifid: capitula solitary, globose, terminal: involucrum 2-series: receptacle hemispherical: flowers yellow.

26. Cyathocline, (Cass. D. C. 5-373). Capitula heterogamous, marginal flowers many series female 3-cleft; central ones obconical male, 5-toothed: achænia oblong, attenuated at both ends, with a short pellucid beak: pappus none, (unless the beak be considered such). Erect herbaceous viscid heavy-smelling plants with alternate bipinnatifid leaves: capitula small racemose, on the ends of longish naked peduncles: involucrum many series: receptacle ebracteolate, the centre elevated saucer-shaped, bearing the male flowers; flowers reddish-purple.

27. Thespis, (D. C. 5, Prod. 375). Capitula heterogamous; marginal flowers many series female very slender:

style scarcely exserted; central ones few, male, with short tube and campanulate limb: anthers included: achænia compressed, glabrous: pappus 7-8 barbellate bristles. Erect ramous glabrous annuals: leaves alternate; peduncles axillary and terminal, bearing few congested capitula: involucrum several series, shorter than the disk: receptacle naked, flat, punctulate; flowers yellow: pappus first white, afterwards reddish.

28. Berthelotia, (D. C. 5-375). Capitula heterogamous; flowers of the circumference many series, female 2-3-toothed; of the disk few (5-12) 5-toothed: achænia terete beakless: pappus 1-series, paleaceous, cohering at the base, scabrous at the apex. A shrub with alternate sessile leaves: capitula oblong, forming dense corymbs on the ends of the branches: involucrum oval, scales several series imbricated, adpressed: receptacle naked, flowers purplish.

29. Conyza, (Less. Syn. D. C. 5-377). Capitula heterogamous: flowers of the circumference many series female, 3-5-toothed; of the disk few male, 5-toothed: achænia compressed attenuated at the base: pappus 1-series, bristles filiform. Erect ramous terete herbs, with alternate leaves and corymbose or subpaniculate pedicelled capitula: involucrum many series; receptacle ebracteolate punctulate or fimbrilliferous: flowers yellow, pappus red or reddish.

Sub-tribe III. Tarchonantheæ. *Capitula either dioicous or heterogamous, never radiate. Female flowers in the circumference many series, very slender; of the disk hermaphrodite or male, fewer and larger: anthers caudate: leaves alternate.*

30. Blumea, (D. C. 5-432). Capitula heterogamous, flowers of the circumference many series truncated, or 2-3-toothed: of the disk few (5-25) cylindrical, 5-toothed, the throat

scarcely dilated : anthers very slenderly caudate at the base : achænia terete : pappus 1-series, bristles capillary, scarcely rough. Herbaceous or suffruticose plants with panicled or loosely corymbose inflorescence: involucrum imbricated many series, scales linear acuminated : receptacle flat, quite naked, or sometimes hairy : flowers yellow or purple.

31. Pluchea, (Cass. D. C. 5-449). Capitula heterogamous : flowers of the circumference many series female, truncated or 2-3-toothed ; central ones few male, or imperfectly hermaphrodite, 5-toothed : anthers bicaudate at the base : achænia erostrate, cylindrical or furrow-angled : pappus 1-series, bristles filiform, scarcely rough. Herbaceous or suffruticose ; leaves alternate, often glanduloso-pubescent : capitula corymbose pedicelled : involucrum many series imbricated : receptacle naked or hairy, fimbrillate : flowers yellow. [This genus appears scarcely distinct from the preceding. D. C. remarks "à Conyza et Blumea antheris caudatis diversum," a very slender difference.]

32. Monenteles, (Labill. D. C. 5-455). Capitulum many flowered ; marginal 2-3-series female, scarcely dentate ; of the disk 1-5-hermaphrodite or male, 5-toothed, subglandulose without : anthers of the disk with subulate spurs : achænia oblong subcompressed sparingly villous : pappus 1-series, bristles filiform, connected at the base. Ramous herbs, leaves decurrent forming wings to the stems : capitula sessile, fasciculed in the axils of the floral leaves forming spikes : involucrum 2-series, persistent, about equal, not imbricated ; receptacle flat, narrow.

33. Epaltes, (Cass. D. C. 5-461). Capitula heterogamous, flowers of the circumference many series, female ; of the disk sterile : anthers included : styles of the disk scarcely exserted, undivided : achænia of the ray obovate, subangled,

glabrous : pappus none. Ramous herbs ; leaves alternate decurrent : peduncles opposite the leaves : involucrum two or several series, imbricated : receptacle naked convex.

Sub-tribe IV. INULEÆ. *Capitula never dioicous, rarely homogamous, often heterogamous, radiate : ligulæ female, isochromous (colour of the disk :) receptacle, except* Rhantarium *epaleaceous : anthers caudate : leaves alternate.*

34. INULA, (Gærtner D.C. 5-463). Capitula heterogamous, flowers of the ray 1-series, female, or sometimes, by abortion, sterile, usually ligulate ; of the disk hermaphrodite tubular 5-toothed : anthers with two bristles at the base : achænia erostrate roundish : pappus uniform, bristles capillary. Herbaceous perennials : capitula at the apices of the branches solitary, often corymbose ; involucrum imbricated many series ; receptacle naked ; flowers yellow.

35. VICOA, (Cass. D. C. 5-474). Capitula heterogamous, flowers of the ray narrow ligulate 1-series ; of the disk tubular 5-toothed : anthers setaceously appendiculate at the base : achænia beakless : pappus of the ray none, of the disk capillary, 1-series. Erect ramous annuals with alternate auriculately sagittate sessile leaves : branches sparingly leafy 1-cephalous : involucrum imbricated, scales subulate ; receptacle ebracteolate ; flowers yellow.

36. CÆSULIA, (Roxb. D. C. 5-482). Capitula numerous, aggregated in a glomerulus, or general head : proper involucrum 2-carinated, membranaceous valves, at length cohering with the ovary and forming a spurious 2-lobed pappus : corolla tubular, 5-lobed, spreading : anthers rigid caudate : branches of the styles filiform diverging [Roxb. Icon. D. C.] or included and shortly spathulate [R. W. Icon.] : achænia compressed, apparently 2-winged from the cohering-involu-

cral scales: pappus wanting [unless the elongated points of the involucrum be considered such.] Herbaceous diffuse plants: leaves alternate dilated amplexicaul at the origin of the flowers: flowers sessile, surrounded by 2-3-orbicular leaves and some small bracts forming the general involucrum, pale violet or white opening from the centre towards the circumference. [This genus seems badly placed here, having apparently no affinity with the plants among which it is stationed.]

Sub-tribe ECLYPTEÆ. *Capitula heterogamous, flowers of the ray female, except* Cryphiospermum *ligulate; of the disk hermaphrodite: anthers ecaudate. Receptacle paleaceous: pappus either none or aristate, never setaceous; leaves opposite.*

37. ECLIPTA, (Lin. D. C. 5-489). Capitula many flowered, heterogamous, of the ray 1-series female, shortly ligulate; of the disk tubular 4-toothed: achænia of the ray triangular, of the disk compressed, tuberculated on the sides, scarcely apiculate. Rough herbaceous plants with opposite leaves and solitary axillary peduncles; involucrum 2-series, scales 10-12; receptacle flat, covered with lanceolate paleæ; flowers white, juice employed to dye black.

38. BLAINVILLEA, (Cass. D. C. 5-492). Capitula heterogamous, flowers of the ray few, 1-series, expanding into a broad, short, irregularly 3-cleft ligula; of the disk tubular 5-cleft: style of the disk included: achænia of the ray triquatrous, bearing 3-rigid persistent ciliate bristles; of the disk compressed biaristate. Herbaceous plants with opposite triplinerved leaves: peduncles axillary monocephalous: involucrum cylindrical, 1-2-series, exterior ones foliacious: receptacle narrow, paleæ embracing the flowers concave, membranaceous; flowers white.

39. SIEGESBECKIA, (Lin. D. C. 5-495). Capitula heterogamous, flowers of the ray 1-series ligulate or deformed; of the disk tubular 3-5-toothed: achænia obovate oblong, somewhat 4-sided, curved within, epappose. Herbaceous dichotomous plants, upper parts viscid: involucrum 2-series; five exterior ones linear spathulate spreading; interior ones involving the achænia of the ray, viscidly pilose on the back; receptacle flat: paleæ embracing the achænia: flowers yellow:

Tribe IV. SENECIONIDEÆ.

Sub-tribe. MELAMPODINEÆ. *Flowers unisexual, no hermaphrodites; male and female in different plants* (dioicous) *or in different capitula of the same plant* (heterocephalous), *or in the same capitulum* (monoicous): *anthers ecaudate; receptacle usually paleaceous: pappus never setose.*

40. XANTHIUM, (Tourn. D. C. 5-522). Capitula monoicous, male, involucrum subglobose many flowered, scales free 1-series; receptacle cylindrical paleaceous: corolla clavate 5-lobed; filaments scarcely adnate to the corolla, anthers free: female, 2-flowers enclosed within a 2-beaked prickly involucrum; corolla filiform; stigmas 2-diverging; achænia one in each cell of the afterwards indurated involucrum. Herbaceous plants with variously divided leaves: capitula irregularly glomerate, spicate, males above, females below. [D. C. well remarks of this "a very abnormal genus among Compositæ, referred by Ventenat to Urticeæ, and by Reichenbach to Cucurbitaceæ." But for the venation of the corolla of the male flowers I would coincide with the former. The female has no corolla except the beaks, through an aperture of which the stigmas pass.]

41. MOONIA, (Arnott. D. C. 7, p. 288). Capitula monoicous; flowers of the ray 1-series female ligulate 3-cleft; of

the disk male: branches of the style of the female linear revolute; style of the male included, simple, or slightly cleft at the apex: achænia obovate, somewhat compressed, entire or shortly bicornate at the apex. Shrubs: leaves opposite; peduncles terminal 1-cephalous: involucrum 2-series, the exterior spreading recurved, interior erect: receptacle paleaceous, paleæ membranous, 1-nerved: flowers yellow. [Owing to the Neilgherry species differing in several particulars from the Ceylon one, I have slightly modified the character for its admission.]

Sub-tribe. HELIANTHEÆ. *Capitula usually heterogamous radiate, or homogamous discoid. Receptacle wholly or at least the margin paleaceous: lobes of the corolla of the hermaphrodite flowers thick: pappus none, crown-like, or aristate; anthers blackish, ecaudate.*

42. WEDELIA, (Jacq. D. C. 5-538). Capitula heterogamous, flowers of the ray 1-series ligulate, female; of the disk hermaphrodite, 5-toothed: branches of the style of the hermaphrodite flowers ending in a cone: achænia obovate or compressed, beakless, with a crown or calyx-like pappus: receptacle paleaceous. Suffruticose or herbaceous, leaves opposite: pedicels terminal or axillary; involucrum 2-3-series, exterior foliaceous: receptacle paleaceous.

43. WOLLASTONIA, (D. C. 5-546). Capitula heterogamous, flowers of the ray ligulate, 1-series, female; of the disk hermaphrodite: corolla articulated above the ovary: achænia thick obovate turbinate or compressed, umbilicate at the apex, or bearing 5-slender aristæ. Suffruticose usually hispid, leaves opposite triplinerved: pedicels at the apices of the branches about 3, one cephalous: involucrum 2-3-series, exterior foliaceous: receptacle paleaceous: flowers yellow.

44. Guizotia, (Cass. D. C. 5-551). Capitula heterogamous, ray ligulate female ; disk hermaphr. tubular 5-toothed, base of the tube of the corolla furnished with a ring of thick jointed hairs: achænia smooth. Herbaceous: flowers large, terminal, pedicelled: involucrum 2-series, foliaceous: receptacle paleaceous: flowers yellow. [The only species G. oleifera (Wight's Illust. tab. 132,) is much cultivated in Mysore as an oil plant. It is a widely distributed plant.

45. Bidens, (Lin. D. C. 5593). Capitula either homogamous discoid, or radiate with the flowers of the ray ligulate neuter : achænia more or less obcompressed, surmounted by an aculeate beak, ending in 2-5-rigid, retrorsely hispid, bristles. Herbaceous annuals with opposite often divided leaves ; involucrum 2-series, scales of each either similar or dissimilar: receptacle flat, paleaceous: flowers usually yellow in one, purple.

46. Spilanthes, (Jacq. D. C. 5-620). Capitula sometimes heterogamous, with the flowers of the ray ligulate female, sometimes homogamous, all the flowers hermaphrodite tubular 4-5-toothed : branches of the style of the hermaphrodite flowers truncated penicilate : achænia of the disk compressed, often ciliate on the edges. Herbaceous annuals: leaves opposite: peduncles 1-cephalous: capitula ovate or conical: involucrum adpressed 2-series, shorter than the disk, exterior ones foliaceous : flowers yellow. Plants usually pungent sialagoges.

47. Ximensia, (Cav. D. C. 527). Capitula many flowered heterogmous, flowers of the ray female ligulate, 1-series ; of the disk hermaphrodite tubular 5-toothed : tube of the corolla hispid : branches of the disk styles appendiculate at the apex: achænia compressed, winged, deeply emarginate, subpilose, biaristate ; aristæ cohering with the sides of the

wings. Herbaceous annuals with opposite or alternate dentate leaves: petioles winged and auricled at the base: capitula loosely corymbose: receptacle convex paleaceous: paleæ membranaceous lanceolate: flowers yellow. [D. C. seems not to regard this as an Indian genus: but as I have, apparently, native specimens, which may however have been introduced, I give it a place in this list.]

48. CHRYSANTHELLUM, (Rich. D. C. 5-630). Capitula radiate ligulæ 1-series female, linear bidentate; disk hermaphrodite, 5-toothed: branches of the style in the hermaphrodite flowers appendiculate: achænia bald, exterior ones oblong, emarginate or with a short cartilaginous wing on each side. Herbaceous annuals: branches 1-cephalous at the apex: capitula small: involucrum 2-series: scales of the exterior ones shorter, interior 10, somewhat coloured; receptacle flat: with linear paleæ: flowers yellow.

49. GLOSSOCARDIA, (Cass. D. C. 5-631). Capitula few flowered, flowers of the ray 1-2 or 0, female; of the disk hermaphrodite, tubular 4-toothed: achænia of the disk obcompressed, very villous on the 4-angles, somewhat 2-winged, crowned with 2-rigid smooth bristles from the lateral angles. Herbaceous diffuse plants with alternate pinnatifid leaves: involucrum oblong, imbricated: receptacle covered with narrow membranaceous paleæ: capitula short peduncled: flowers yellow.

50. GLOSSOGYNE, (Cass. D. C. 5-632). Capitula heterogamous, flowers of the ray ligulate, female; of the disk hermaphrodite: styles of the hermaphrodite short, elongated into two long rough stigmas: achænia linear, angled, bearing two retrorsely hispid bristles. Erect glabrous herbs, with alternate pinnatifid leaves congested near the base: stems nearly naked: capitula erect ebracteate: involucrum short adpressed, 2-series: receptacle paleolate: flowers yellow.

Sub-tribe. FLAVERIEÆ. *Capitula heterogamous, one or few flowered, densely aggregated female flowers sometimes solitary, sometimes in several series; or homogamous, mixed with former: achænia bald: receptacle in the few flowered capitula epaliate, in the many flowered ones, paleaceous.*

51. ENHYDRA, (Lour. D. C. 5-636). Capitula heterogamous, all the flowers wrapped in a folded palea; exterior ones many series, female; interior hermaphrodite sterile; tube of the ray florets filiform, of the disk subconical: limb of the ray subligulate 3-4-cleft, of the disk 5-cleft: stigmas exserted revolute, rough towards the apex: achænia bald, erostrate, altogether wrapped in the palea. Aquatic rooting opposite leaved herbs, with axillary capitula: receptacle small flattish: paleæ as if 2-valved connivent: involucrum 4-leaved, two opposite, larger: flowers white.

Sub-tribe. ANTHEMIDEÆ. *Capitula usually heterogamous, radiate or discoid: ligulae female or neuter: anthers ecaudate: branches of the style truncated, bearded, very rarely surmounted by a cone: achænia angled, terete, or obcompressed in the ray: pappus none or crown-like, rarely consisting of squamellæ or capillary hairs: leaves usually alternate.*

52. MATRICARIA, (Lin. D. C. 6-50). Capitula heterogamous, ray ligulate 1-series female; disk hermaphrodite 4-5-toothed, tube terete: achænia wingless, angled, surmounted by a large epigynous disk, usually bald, rarely furnished with a crown-like pappus. Annuals with much divided leaves; branches naked 1-cephalous: involucrum imbricated, several series: receptacle large, naked ovato-conical: disk yellow, ray white.

53. PYRETHRUM, (Gærtn. D. C. 6-53). Differs from the preceding in the achænia not being surmounted by an epigynous disk, but furnished with a crown-like, often toothed or

auricle-like pappus equal to its diameter. Annuals or perennials, leaves alternate, dentate, or lobed : involucrum campanulate, scales scariose on the margin : receptacle flat, naked or sometimes bracteolate : disk yellow, ray white or yellow. [To this genus Chrysanthemum Indicum of the gardens, belongs.]

54. Chrysanthemum, (D. C. 6-63). This genus differs from the two preceding in having the achænia of the ray 3-winged, two lateral and the 3rd on the interior side, those of the disk roundish, with a short wing on the interior side. Herbs or shrubs : ligula white or yellow, or white with a yellow tube : disk yellow or rarely purple.

55. Artemisia, (Lin. D. C. 6-93). Capitula discoid, homogamous or heterogamous : flowers of the circumference 1-series, usually female 3-toothed, with a long exserted bifid style ; of the centre 5-toothed, hermaphrodite or male by abortion : achænia obovate bald with a minute epigynous disk. Herbaceous or suffruticose : leaves alternate, variously lobed ; capitula spicate or racemose : involucrum imbricated : scales dry on the margin : receptacle epaleaceous, naked or hairy : flowers yellow or purple. Plants more or less bitter and aromatic.

56. Tanacetum, (Less. D. C. 6-127). Capitula homo or heterogamous, one row of 3-4-toothed female flowers in the circumference, those of the disk 4-5-toothed : achænia angled glabrous, with a large epigynous disk : pappus none or membranaceous crown-like. Herbs or shrubs, leaves variously divided : capitula solitary or corymbose, globose : involucrum campanulate, imbricated : receptacle naked, convex : flowers yellow.

57. Myriogyne, (Less. D. C. 6-139). Capitula heterogamous, marginal flowers many series female tubular scarcely

dentate; central few hermaphrodite 4-toothed, with a short tube and campanulate limb: achænia angled, wingless, epappose. Very ramous diffuse herbs: leaves alternate, obovate, dentate: capitula small, first terminal, afterwards lateral: involucrum 2-series: receptacle naked convex: flowers yellow. Properties acrid and sternulatory.

58. Sphæromorphæa, (D. C. 6-140). Capitula heterogamous, marginal flowers many series, female, scarcely dentate; central few, 4-toothed: style bulbous at the base: achænia cylindrical striated epappose. Decumbent herbs with alternate leaves; capitula globose, depressed, axillary: involucrum campanulate 2-3-series, longer than the flowers: receptacle naked [D. C. asks if this is sufficiently distinct from Myriogyne.]

59. Machlis, (D. C. 6-140). Capitula heterogamous: marginal flowers many series not furnished with a corolla? or very minute; central ones numerous: corolla obconical, 4-toothed: stigmas bearded at the apex: achænia terete, subangled subglandulose; of the marginal flowers bidentate, of the centre truncated at the apex. Herbs with alternate multifid pinnate leaves: capitula pedicelled, axillary: involucrum 2-series: receptacle naked punctulate.

Sub-tribe. Gnaphalieæ. *Capitula homogamous or heterogamous discoid, very rarely radiate, sometimes 1-flowered: anthers caudate: achænia crowned with a pilose or setaceous pappus, very rarely bald: leaves usually alternate.*

60. Helichrysum, (D. C. 6-169). Capitula sometimes homogamous, flowers all hermaphrodite 5-toothed; sometimes heterogamous, marginal flowers often very few, 1-series, female: achænia beakless, sessile, with a terminal areola: pappus 1-series, setæ roughish not plumose. Herbs or shrubs with alternate leaves: involucrum imbricated, scales

scariose, interior ones connivent or radiant: receptacle flat epaleaceous, naked, areolate or fimbriliferous: involucra white, purple, or yellow: corolla yellow or purple.

61. Gnaphalium, (Don. D. C. 6-221). Capitulum heterogamous, flowers all tubular, marginal ones, many series, female; disk ones hermaphrodite: achænia somewhat terete, subpappillose: pappus 1-series, scarcely rough. Herbaceous or suffruticose, generally woolly or tomentose plants, capitula often disposed in glomerulus, terminal or axillary, fascicled, corymbose, or spicate: involucra white, red, purple or yellow.

62. Filago, (Tourn. D. C. 6-247). Capitula heterogamous, marginal flowers numerous, on an elongated filiform receptacle, the apex only dilated and bearing a few male or hermaphrodite flowers: achænia terete papillose: pappus of the central ones, setose filiform, of the margin wanting or dissimilar. Tomentose herbs: capitula axillary or aggregated on the ends of the branches, small. [There is a descrepancy between this generic character and that of F. *prostrata,* the central florets of that species being without pappus, the marginal ones having it: neither do I find paleæ on the receptacle of that species.]

63. Antennaria, (Brown D. C. 6-269). Capitula dioicous or subdioicous, with an alveolate convex receptacle; female flowers filiform 5-toothed; male, anthers half exserted: achænia terete: pappus 1-series, setæ of the female flowers filiform, of the male clavate. Herbaceous or suffruticose: capitula corymbose: involucrum imbricated, variously coloured at the apex or scariose, never yellow: flowers yellow.

64. Anaphalis, (D. C. 6-271). Capitula heterogamous discoid; marginal flowers few or many series female; disk ones hermaphrodite sterile 5-toothed: styles of the marginal

florets long exserted bifid, of the disk undivided obtuse: achænia glabrous, obcompressed, sessile, erostrate: pappus 1-series uniform, bristles rough not clavate. Herbaceous or suffruticose woolly or tomentose plants: stems sometimes 1-cephalous, oftener polycephalous, corymbose: scales of the involucrum niveo-scariose lanceolate several series, the middle ones with a brownish claw: receptacle convex, alveolate. [This genus, judging from specimens named by D. C., ought never to have been separated from Gnaphalium, as there is not a single distinguishing mark of the least value or constancy between them, and several species I have carefully examined may be placed in either or neither genus, as agreeing with neither, but too closely allied to both to form a separate genus; the two genera reunited, would give good characters, but divided, they neutralize each other and become of no value.]

65. Leontopodium, (Brown D. C. 6-275). Capitula heterogamous, ray flowers female: 1 or several series: 3-4 denticulate, disk bisexual-sterile infundibuliform 5-toothed, the style clavate at the apex: achænia cylindrico-compressed: pappus of the female barbellate, of the sterile flowers usually clavate. Perennial mountain herbs, woolly-tomentose; leaves oblong or the lower one obovata; capitula terminal, umbellato-corymbose, middle capitulum of the central corymb sessile, the female flowers 1-series ebractiolate earlier; the lateral ones short pedicelled, females many series, furnished with a woolly foliaceous bractea, therefore a glomerulate, bound by radiating floral leaves: scales of the involucrum adpressed woolly receptacle, convex foviolate, [apparently scarcely distinct from the preceding.]

66. Carpesium, (Lin. D. C. 6-281). Capitula heterogamous discoid, marginal flowers female several series, disk hermaphrodite: anthers caudate: branches of the style terete, obtuse, subglabrous: achænia oblong, compressed rostrate

rostrum beset with viscid glands : pappus 0. Herbaceous erect, leaves alternate: capitula solitary on the ends of the branches : involucrum many series imbricate, exterior ones sometimes foliaceous : flowers yellow.

Sub-tribe. SENECIONEÆ. *Capitula homogamous or heterogamous, discoid or radiate : anthers ecaudate : achænia crowned with setaceous or pilose pappus, the marginal ones sometimes bald : leaves alternate.*

67. CREMOCEPHALUM, (Cass. D. C. 6-297). Capitula heterogamous, marginal flowers few, filiform, female : branches of the style crowned with a short hispid cone : achænia terete, 10-ribbed : pappus pilose, soft, several series. Herbs, branches long naked 1-cephalous : involucrum many leaved, not imbricated, calyculate : receptacle fimbriliferous, afterwards becoming, with the base of the involucrum, thickened ; flowers purple.

68. GYNURA, (Cass. D. C. 6-298). Capitula discoid homogamous : base of the tube of the corolla corneus : branches of the style produced into a long hispid appendage, usually exserted : achænia terete, striated, beakless : pappus many series filiform, scarcely barbellate. Herbaceous or shrubby ; capitula corymbose : involucrum cylindrical 1-series, calyculate at the base with subulate bracts : receptacle flat alveolate : flowers white.

69. EMILIA, (Cass. D. C. 6-301). Capitula homogamous discoid : flowers 5-lobed : branches of the style ending in a cone : achænia oblong pentagonal, angles ciliate hispid : pappus several series filiform, scarcely barbellate.—Herbs, with few subcorymbose pedicelled capitula : involucrum cylindrical 1-series, ecalyculate : flowers reddish, purple, or orange coloured.

70. LIGULARIA, (Cass. D. C. 6-313). Capitula radiate, ray 1-series ligulate female, often biligulate, or retaining rudiments of the stamens: branches of the styles of the disk obtuse, clothed with long descending pubescence: achænia beakless, sulcated, terete: pappus uniform, pilose, many series. Herbaceous plants: capitula large yellow, arranged in racemes or thyrses or solitary: involucrum campanulate, 1 series: receptacle naked.

71. DORONICUM, (Lin. D. C. 6-320). Capitula radiate heterogamous: ray florets 1-series ligulate, female or sterile by abortion; disk hermaphrodite: achænia beakless, oblong, turbinate, furrowed; of the ray bald, of the disk pappose: pappus setaceous several series. Herbaceous plants, with solitary or several capitula; involucrum few series, scales linear: receptacle convex ebracteolate. [Almost the only distinction between this genus and Senecio consists in the marginal florets, in this having *no pappus,* in that being furnished *with pappus* similar to those of the disk.]

72. MADACARPUS, (R. W. Calcutta Journal). Capitula radiate heterogamous: ray flowers 1-series ligulate sterile; disk ones numerous hermaphrodite: achænia beakless, oblong, furrowed, hairy, without pappus. Herbaceous plants: capitula corymbose: involucrum campanulate 1-series, scales linear, lanceolate, mucronate: receptacle convex foviolate: corolla subinfudibuliform, costæ of the achænia hispid.

73. SENECIO. Capitula homogamous discoid, or heterogamous radiate: flowers of the ray ligulate female: branches of the style of the hermaphrodite flowers truncated, the point only penicillate: achænia beakless, terete or angularly furrowed: pappus pilose several series, caducous. Herbaceous or shrubby, sometimes climbing plants, with solitary or corymbose inflorescence: involucrum one series, sometimes naked some-

times calyculate with accessory squamellæ, often with the points of the scales sphacellate: receptacle naked alveolate. [D. C.'s list of species of this genus exceeds 600. It is therefore by much the largest genus of the vegetable kingdom.]

74. NOTONIA, (D. C. 6-44). Capitula discoid homogamous: flowers 5-toothed: branches of the style ending in a short hispid cone: achænia terete, many striated glabrous: pappus many series, setæ filiform, barbellate. Shrubby, succulent plants with corymbose, few headed, inflorescence: capitula, as compared with the above genera, large: involucrum cylindrical 1-series, ecalyculate, the peduncle furnished with a few bracteaceous scales: receptacle alveolate, naked or slightly fimbriliferous: flowers longer than the involucrum, pale yellow or cream coloured.

75. MADARACTIS, (D. C. 6-439). I exclude this genus as being identical with *Doronicum*, and all its species previously described under that name. *M. pinatifida* is *D. candolianum*—*M. scabra*, *D. Lessingianum*—*M. polycephala*, *D. Arnottii*—*M. glabra*, *D. Wightii*. The distinctive characters of the two genera are, that in Doronicum the ray florets are *female*, in Madaractis *neuter*. In the character above given, I have combined them thus: "ray florets 1-series female or sterile by abortion."

Tribe V. CYNAREÆ.

Sub-tribe. ECHINOPSIDEÆ. *Capitula sessile one-flowered, aggregated into a globose glomorulus, with numerous involucral foliola, articulated on a globose common receptacle.*

76. ECHINOPS, (Lin. D. C. 6-522). Capitula numerous, aggregated on a naked globose receptacle, the centre one opening first: corolla tubular 5-cleft: anthers ecaudate:

achænia cylindrical silky villous: pappus short, crown-like, the hairs somewhat fimbriated. Erect prickly plants: glomorulus sphærical: capitula inserted on a circular horny areola: partial involucrum 3-series: the interior scales the longest, linear acuminated carinate. Flowers blue or white.

Sub-tribe. CARLINEÆ. *Capitula many flowered, never dioicous: scales of the involucrum many series, distinct, often spinous: hermaphrodite corolla 5-cleft, female or sterile deformed: filaments free, naked: anthers usually furnished with a long bearded cauda: achænia usually villous: pappus 1-2-series, pilose or plumose, rarely ramose.*

77. SAUSSUREA, (D. C. 6-531). Capitula homogamous: corolla slender, throat ventricose: anthers ending in long appendices with 2-ciliate, bristled at the base: stigmata long, diverging, continuous with the style: achænia glabrous: pappus usually double, paleæ of the exterior subfiliform rough, sometimes wanting, interior long plumose concreted at the base into a deciduous ring. Herbs with entire leaves: capitula usually corymbose: involucrum many series: receptacle fimbrillate or paleaceous, palea persistent: corolla purple or white, never yellow.

78. APLOTAXIS, (D. C. 6-538). Similar to Saussureæ, except that the pappus is one series plumose. [Surely this is an unnecessary refinement, especially as it is said of the exterior series of Saussureæ "*raro exter. deficiente nullus*," and Captain Munro, from whom I have a specimen collected by himself, informs me, that *Ap. gossipina* " is an undoubted Saussurea."

79. DOLOMIÆA, (D. C. 6-542). Capitula homogamous: corolla slender, dilated at the base: anthers appendiculate and caudate at the base; caudæ intorted ciliate: style thickened at

the apex, ovarium glabrous, somewhat 4-sided: pappus long violaceous, bristles rough, concreted into a ring at the base. A herbaceous unarmed plant, radicle leaves pinnatifid: capitula short peduncled, aggregated into an irregular head: involucrum ovate many series, squamæ acuminate: receptacle flat, covered with fimbrillæ forming alveolæ: corolla purple, an inch long.

80. AMBERBOA (Isn. D. C. 6-558). Capitula several flowered heterogamous marginal ones larger sterile: achænia compressed or turbinate, tetragonal, with a lateral or basilar areola: pappus paleaceous, paleæ obovate spatulate. Herbaceous plants: involucrum many series, scales various, rarely spinescent; flowers blue or reddish purple.

81. MICROLONCHUS, (D. C. 6-562). Capitula many flowered, flowers of the ray neuter, more or less enlarged: filaments pappillose: anthers ecaudate: achænia compressed with a lateral areola: pappus double, interior unilateral, broad at the base, acuminate at the apex, about the length of the exterior pappus. Perennial glabrous herbs: floriferous branches naked 1-cephalous: involucrum ovate, scales adpressed coriaceous, with a short reflexed deciduous apex, or produced into a long spine-like appendage; flowers, purple or white or yellowish.

82. TRICHOLEPIS, (D. C. 6-563). Capitula homogamous: corolla subregular 5-fid: achænia with a lateral areola, crowned at the apex with a circular margin: pappus setaceous concrete at the base, or paleaceous not concrete, or wanting. Herbaceous plants: capitula ebracteolate: involucrum many series, scales linear setaceous, recurved at the points: receptacle fimbriliferous.

83. CARTHAMUS, (Tourn. D. C. 6-611). Capitula homogamous: corolla 5-cleft, tube enlarged above the disk:

stigmata scarcely distinct: achænia obovate, tetragonal, glabrous, smooth: pappus wanting. Herbaceous plants: involucrum several series, exterior foliacious, middle ones with an ovate spiny appendix; interior acuminate pungent: receptacle loaded with linear fimbrillæ: flowers yellow or orange coloured.

84. Cirsium, (Tourn. D. C. 6-634). Capitula homogamous: flowers hermaphrodite or dioicous: tube of the corolla short, throat oblong 5-cleft: anthers ecaudate: stigmas concreted: achænia oblong, compressed, glabrous, membranaceous, ecostate, with a fleshy terminal areola. Herbaceous thistle-like plants: involucrum imbricated, scales more or less prickly pointed: receptacle fimbriliferous: flowers purple or yellow.

85. Chamæpeuce, (Pr. Alp. D. C. 6-657). Capitula homogamous: corolla 5-cleft, equal or subringent: filaments plumose or hairy: anthers with an oblong acute appendiculus, and long lacerated cauda: stigmas scarcely free at the point: achænia obovate with a hard testa: setæ of the pappus plumose, one or several series. Suffruticose or herbaceous plants, with prickly leaves: capitula terminal or axillary: involucrum imbricated, scales more or less pungent: receptacle fimbriliferous: flowers purple or white.

86. Echenais, (Cass. D. C. 6-660). Differs from the preceding, in the achænia being striated and the pappus double; the exterior setæ short, the interior longer, dilated at the apex into a flattened nail-like membranaceous disk. Erect herbaceous plants: capitula nodding: flowers white.

87. Serratula, (D. C. 6-667). Capitula usually homogamous sometimes by abortion, 1-sexual, or the ray female: corolla 5-cleft, subirregular: filaments pilose: stigmas diverg-

ing: achænia oblong, compressed, hilum oblique: pappus unequal, hairs many series; rough, not annulate. Unarmed or prickly herbs: involucrum ovate, scales imbricated, the exterior ones shorter spinulose, interior long scariose at the apex; receptacle fimbrillate: corolla purple or white, never yellow.

88. JURINEA, (Cass. D. C. 6-673). Capitula homogamous: corolla longer than the involucrum: stigmas distinct: achænia obpyramidal 4-sided, with an apicular areola, afterwards growing into deciduous shield, bearing the pappus: pappus rising within a minute calyciform margin, thick, unequal, barbellate. Herbaceous perennials, leaves white tomentose beneath: involucrum subglobose or cylindrical, scales imbricated, unarmed, adpressed: fimbrillæ of the receptacle cleft into linear bristles: flowers purple.

Tribe VI. MUTISIACEÆ.

Sub-tribe. MUTISEÆ. *Capitula very rarely 1-flowered, usually 1-series of females in the margin, the rest hermaphrodite: style thick, branches exteriorly very convex in the hermaphrodite ones; the exterior as well as the superior part of the style puberulous or glabrous: pollen often slightly elliptic: shrubs or large herbs with large handsome capitula.*

89. AINSLIÆA, (D. C. 7-13). Capitula 3-flowered, homogamous: corolla tubular bilabiate, exterior lip 3, interior 2-cleft: anthers appendiculate, with long spurs at the base: stigmas exserted, obtuse, glabrous, often by abortion unequal, acute, or one altogether abortive: achænia terete, villous erostrate: pappus 1-series, setæ elegantly plumose. Herbaceous perennials; stems erect, simple: involucrum cylindrical, scales lanceolate, acuminated, imbricate: receptacle naked: flowers purple. [This genus is dedicated to the late Dr.

Whitelaw Ainslie, of Madras, an honour well merited in return for his most valuable Materia Medica of Hindoostan.]

90. ÆREOSERIS, (D. C. 7-17). Capitula heterogamous, radiate-like: marginal flowers female; disk hermaphrodite; corolla bilabiate 2-3-cleft: exterior lip of the ray ligulate 3-cleft: anthers long-spurred, spurs lacerated at the point: style tumid at the base, branches short obtuse: achænia oblong puberulous: pappus 2-series, setæ serrated, equal. Herbs: radical leaves lyrate or pinnatifid, tomentose beneath: scape 1-cephalous: involucrum two or more series, scales acuminated: receptacle naked: flowers yellow.

91. LEUCOMERIS, (Don. D. C. 7-25). Capitula 4-6-flowered, homogamous: corolla tubular 5-cleft, lobes linear subcallous at the apex: anthers elongated, caudæ plumose: style bulbous at the base, scarcely exserted; branches short, obtuse, glabrous: achænia covered with silky villi surrounding the apex like calycled pappus: pappus several series, rough, rigid. Shrubs or herbs: leaves alternate tomentose beneath: capitula corymbosely fascicled: involucrum glabrous cylindrical, imbricated: receptacle naked: corolla purplish: anthers white.

92. DICOMA, (Less. D. C. 7-35). Capitula homogamous or heterogamous: corolla of the disk regular 5-parted; of the ray, in heterogamous capitula, neuter, ligulate, bilabiate or roundish tubulate: anthers long, caudate, caudæ bearded: branches of the style short, erect, obtuse, hispidulous at the apex: achænia turbinate, often 10-ribbed: pappus two or more series. Suffruticose or herbaceous: leaves alternate: capitula solitary: involucrum campanulate: scales obsoletely many nerved, sometimes pungent: receptacle alveolate: flowers white or purple.

Tribe VIII. Cichoraceæ.

Sub-tribe. Scorzonereæ. *Receptacle epaleaceous ; pappus paleolate, paleola rough or plumose.*

93. Tragopogon, (Tourn. D. C. 7-112). Capitula many flowered; flowers of the ray often radiant: achænia with a lateral areola, more or less muricated, long beaked: pappus plumose, five of the sæta longer and naked at the apex. Biennials or perennials: roots thick lactescent: stems herbaceous erect: capitula terminal: involucrum 1-series: receptacle epaliaceous foviolate.

Sub-tribe. Lactuceæ. *Receptacle epaleaceous or rarely paleaceous : pappus hair-like, fugaceous, soft, silvery white.*

94. Picris, (Juss. D. C. 7-128). Capitula many flowered: achænia terete, attenuated at both ends, rugulose with a terminal areola, beak none or short: pappus of the disk plumose 2-series, exterior shortest. Herbaceous plants: capitula peduncled: involucrum 2-series: receptacle naked.

95. Lactuca, (Tourn. D. C. 7-133). Capitula few or many flowered: achænia compressed, wingless, abruptly terminating in a filiform beak. Herbaceous: capitula paniculate: involucrum cylindrical, calyculately imbricated, 2-4-series: receptacle naked. [The essential distinction of this genus is the filiform beak of the achænia, which is most marked in the common garden lettuce, but does not exist in either *L. glabra* or *L. Heyneana,* the only two Indian species I have examined. The former of these seems to associate better with *Microrhynchus ;* the latter with *Brachyramphus.*]

96. Ixeris, (Cass. D. C. 7-151). Capitula many flowered: achænia oblong, acutely 10-costate beaked: pappus pilose

1-series. Herbaceous: stems naked at the apex corymbose: involucrum ovate 1-series, with 3-5-calyculate scales; receptacle naked. [This genus, so far as I can learn from written characters, is not distinct from *Lactuca*, *L. sativa* being apparently about as justly referable to the one as the other.]

97. Brachyramphus, (D. C. 7-176). Capitula 10-15-flowered: achænia oblong muricate, suddenly attenuated into a short beak, neither angled nor costate: pappus many series. Herbaceous: capitula racemosely spicate: involucrum oblong imbricated, the scales scariose on the margin: receptacle naked.

98. Microrhynchus, (Less. D. C. 7-180). Capitula several flowered: achænia 4, rarely 5-angled, subrostrate at maturity; beak wanting in the ovary: costæ thick subbrugose: pappus pilose. Herbaceous perennials: involucrum cylindrical calyculate, imbricate at the base: receptacle naked: flowers yellow.

99. Sonchus, (Cass. D. C. 7-184). Capitula many flowered: achænia wingless, compressed, erostrate, longitudinally costulate; costulæ often transversely tuberculato-muricato: pappus soft, most slenderly filiform. Herbaceous polymorphous plants: involucrum imbricated: receptacle naked: flowers yellow.

100. Youngia, (Cass. D. C. 7-192). Capitula about 12-flowered: corolla pilose at the apex of the tube: achænia oblong, compressed, subtrigonous, striated, beakless, attenuated at both ends: pappus pilose, scarcely denticulate. Herbaceous plants: inferior leaves lyrate or pinnatifid: capitula paniculate: involucrum cylindrical 8-leaved, with about 5-calyculate accessory scales: receptacle naked. [D. C. con-

siders this a good genus, but adds that all the species require to be re-examined.]

101. Prenanthes, (Cass. D. C. 7-194). Capitula 3-5-flowered: style exserted: achænia attenuated at the base, subcylindrical or subpentagonal, truncated: pappus many series, pilose rigid. Herbs with entire or dentate leaves: racemose or paniculate drooping capitula, with 4-6-leaved cylindrical involucra, calyculate at the base: flowers purple.

Sub-tribe. Hieracieæ. *Receptacle epaleaceous: pappus filiform, rigid, fragile, becoming dirty white or yellow.*

102. Dubyæa, (D. C. 7-247). Capitula many flowered; achænia compressed, striated, ending in a short thick neck: pappus many series, white. Herbs with undivided dentate leaves: capitula few subcorymbose: involucrum campanulate, imbricated, exteriorly hispid or prickly: corolla yellow.

103. Mulgedium, (Cass. D. C. 7-247). Capitula many flowered: achænia glabrous compressed, often nerved on both sides, attenuated upwards into a short thick beak expanding at the apex into a cup-shaped disk: pappus one or several series, setæ rigid, rough, greyish or white. Erect ramous herbs, with pinnatifid leaves and racemose or panicled capitula: involucra calyculately imbricate, that is, the exterior scales are much shorter and subimbricate: receptacle naked foviolate: flowers blue or purple.

Note on two undescribed species of Melastoma. Extract of a letter from Mr. J. W. Masters, *Assam.*

"No. 146 in Herbarium, No. 1220 in Collecting Book.

"Melastoma Jenkinsii, Masters.

"A straggling shrub found on the banks of the Lohit, by Major Jenkins. *Bark* scabrous; young shoots somewhat 4-sided, and clothed with roughish down. *Leaves* opposite, large, about seven inches long by three broad, boldly 5-nerved, with a fainter nerve close to the margin; connecting-veins prominent and parallel, lanceolate, acuminate, rounded at the base; nerves coloured; margins dentate; petioles about an inch long, fringed on the upper surface. *Flowers* in terminal drooping racemes; racemes from six to twelve inches long, of a beautiful bright carmine, (puniceous). *Bractes* 2, remote 3-nerved, calyx 4-sided, 4-partite, *not* hairly, *not* clothed with ciliate scales; segments persistent; tube longer than the ovarium, sprinkled with downy specks. *Corolla* 4-petalled deciduous. *Stamens* 8; anthers dissimilar, yellow, erect, 4, pink coloured, pedicelled, with a 2-lobed process at the base. *Style* simple, shorter than the stamens. *Capsule* 4-celled, many seeded.—Saikwah, December, 1843, found also on the banks of the Soondree, near the Duphla Hills, October, 1845.

"The following also, may not be altogether unacceptable. I cannot find any description that agrees well with it in Roxburgh, Wight, or Jack, these are the only works I have to refer to—

"No. 148 in Herbarium, No. 151 in Collecting Book.

"Melastoma Griffithiana, Masters.

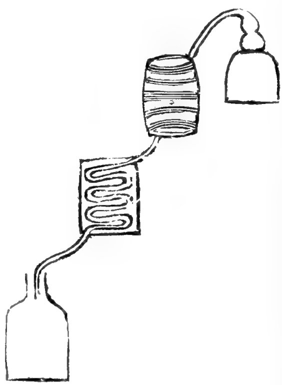
"A very elegant dwarf shrub, with numerous purple flowers, it is every where densely covered with long stiffish hairs, often swollen, and coloured at the base. *Branches* 4-sided, 4-angled. *Leaves* opposite, short petioled, lanceolate rounded at the base, 5-nerved. *Flowers* in large terminal panicles; pedicels short. *Calyx* urceolate; tube much longer than the

ovarium, coloured, with stellate bristles; 4-partite or toothed, segments or teeth lanceolate, with stellate points, alternating with stellate bristles. *Petals* 4, purple. *Stamens* 8, similar. *Style* oblique, incurved; stigma green; ovarium included in the calyx tube with a ciliate crown; capsule 4-celled, many seeded.—Found at Seebsagur, July 1844, and June 1843."

On the Extract of Gunjah or Indian Hemp. By ANDREW ROBERTSON, *Lecturer on Chemistry, Medical College.*

As, owing to the great bulk of the material, it would have been necessary to use a much larger quantity of spirit, had the usual process of digestion in alcohol been followed, a new method of extracting the resin from the plant was resorted to, with the intention of economising alcohol, and also of obtaining a product of better quality. The result was found to have fulfilled both of these views so well, that this mode of procedure may be recommended as an excellent one for preparing not only this, but all similar resinous extracts.

The details of the process are as follows—The Gunjah was freed from the larger stalks, and the small twigs with their leaves, which contain a little resin, as well as the heads, which are loaded with it, were put into a clean, tight, oaken cask, the bunghole of which had been enlarged to admit of their insertion into it. This was then closely stopped up. A tinned copper vessel would have been much better, but the expense of this was too great to be incurred for a temporary purpose. The cask was a fifty gallon one, and contained about a maund and a half of the hemp.



A coupling screw had been previously firmly attached to a hole in the bottom of the cask, so as to be completely spirit-tight. To this was screwed a coiled flexible metal-pipe of half an inch bore, to act as a condensing and cooling worm, and this was immersed in a vessel of water. The end of the pipe terminated in a large carboy, the neck of which was stopped, but not too closely.

The pipe or nose of a twenty gallon still, charged with rum, was then inserted into a hole, made to fit it, within two inches of the top of the cask, and luted very tight. This was necessary, as there was a considerable pressure of the alcoholic vapour, particularly in the upper part of the cask.

The contents of the still were then made to boil until the spirituous part was exhausted, as ascertained by a stop-cock in the top of the still. The water was then run out of the still, a fresh charge of rum introduced, and the same procedure again repeated.

Alcoholic vapour from the rum was thus caused to act on the hemp, to condense among it, and to extract its resin in the most advantageous manner. The solution issued at first from the worm of a deep green colour, and of the consistence of honey; towards the end of the process it became fluid and brown coloured. The passage of the spirit was continued until no appreciable quantity of resin could be detected in the liquid issuing from the worm. The remainder of spirit in the exhausted hemp was expelled from it as far as possible by the slow percolation of water down through the cask.

The resinous solution obtained was again put into the clean still, and as much of the spirit was recovered by a slow distillation as it was judged could be done without endangering the quality of the extract. The quantity recovered was about one-half of that used, the rest being dissipated through the fissures of the apparatus, retained in the residuum, or purposely allowed to remain in the concentrated alcoholic solution.

This concentrated solution, still strongly spirituous, was transferred to large Wedgewood-ware capsules, and evaporated, at a heat not exceeding 150° Fahrenheit, on a large sand bath with a gentle fire beneath five inches depth of sand, so as to give a steady heat, until all the spirit was dissipated. The resin now floated on the surface of a deep brown coloured watery extract, about equal in bulk to it. With the hands well wetted, so as to prevent adhesion, this resin may easily be made into a thin roll, and introduced into a common bottle, where it soon settles down into a compact mass, from which any aqueous fluid may be poured off. When the bottle is filled and well corked, it keeps well and retains its smell and colour; but if the air finds admittance, it becomes darker coloured and its virtue is impaired.

The aqueous part, when evaporated, yields a brown extract, of about one-tenth of the weight of the resinous matter, which seems not to be materially different from any similar watery extract from an inert dried plant. This conclusion, however, was drawn from its sensible properties only, as no chemical or medical trial was made of it. The alcohol, distilled off from the solution, has a strong smell of the plant, probably owing to the presence of essential oil.

Badly prepared resinous extract, as made by the process of Dr. O'Shaughnessy, some of which I have seen, is more of a brown than a green colour, and according to a report made to me from the Medical College Hospital, it must be administered in six times the dose to produce the same effect as that procured from the extract made by the method I have indicated. Good resinous extract is soft and adhesive, of a fine deep green, like the colour of the paint named sap-green, when spread thin upon paper, but greenish black in the mass. It has strongly the peculiar smell of the plant. It is very soluble in alcohol, to which it communicates a fine green tint of a shade rather deeper than a grass green.

In regard to the yield of the plant in resin—Uncommonly good, with many flowering heads, may yield 10 per cent., but

indifferent parcels not much more than half of this. An average yield, from upwards of thirty pounds of extract which I have made, may be from six to seven pounds of extract from a bazaar maund of hemp; to exhaust which quantity, about forty gallons of rum of a strength above London proof, were required.

The process I have mentioned is a tedious though a good one. With a maund and a half of hemp, one week was occupied in distilling rum through the cask; two days in distilling the alcoholic fluid; and four, in the subsequent evaporation in capsules. A quicker procedure, unless by a vacuum apparatus, would give a product of inferior quality.

In the process given, the hemp is never exposed to a heat even approaching the boiling point of water. In Dr. O'Shaughnessy's process, as detailed in the Bengal Pharmacopœia, either from oversight or neglect of the now well understood principle of organic pharmacy, to make all extracts, especially when the substance is possessed of great activity, at as low a heat as possible, it is directed that the hemp shall be *boiled thrice*, for half an hour each time, in "strong spirit." The process as originally conducted by him in the Medical College was still more objectionable in this respect, as the boiling was made in a Papin's digester, under augmented heat and pressure. Hence may have originated the bad quality of the extract first sent to London, and the consequent prejudice against it on the part of many medical men. The extract made according to the directions given in the Bengal Pharmacopœia, will not only be much inferior in quality to that made by this other process, but more than four times the quantity of spirit will be expended in making it.

That such a prejudice against this preparation does exist, in Edinburgh at least, is distinctly stated in a letter received from a scientific correspondent there—"This medicine was brought into some disrepute, I believe, with medical men here, in consequence of Dr. O'Shaughnessy's description being

quite different from the effects they obtained from extracts made in this country from the dried herb." From this it appears that the reputed virtues of this substance are there considered to be rather apocryphal.

A fair trial of this medicine, and an impartial scientific report on it by highly qualified persons, may, however, be soon expected from Paris and Berlin, as Dr. Mouat, a considerable time ago, sent a large quantity of it, prepared by this process, to both of these places.

It is to be regretted that any circumstance should have prevented an extended trial of it from being made in Edinburgh, as, in one case, in which a practitioner was prevailed on to try it, its use was attended with decided benefit to the patient, though also with its singular effect upon the imagination. I give the passage entire in which this is described in a letter from two most intelligent druggists and chemists of Edinburgh, well known for the many improvements made by them in processes of organic pharmacy. "We were greatly obliged by the pot of extract of Indian hemp you sent us, for which accept of our best thanks. It is a beautiful preparation, and from the little experience we have had of it here, it is very powerful. We have only got the report of one medical gentleman, who had an opportunity of trying it on a patient in the hospital, labouring under spasmodic asthma. The hypnotic effect was quite decided in grain doses. After the first dose the man awoke late at night, and described to the house surgeon a dream he had had, in which he supposed himself in heaven, conversing. He was still under the influence of the drug, while he was relating what had passed in his dream, and, although usually a very dull and heavy-headed man, he described the scenes he had seen, and repeated the conversations he had held, in the most glowing and animated language; stating, at the same time, that his own account was far short of the reality. The man, next morning, however, desired the physician not to give him any more

of these pills; which request was complied with, although during the time he was under the influence of the drug, his respiration was free and entirely in a normal way, unaided by the abdominal muscles usually called into much play to help the otherwise laboured breathing. So sensible was he of this benefit derived from the medicine, that, I believe he again desired he might have it. Dr. R ———, under whose care he was, promised to give us a report of the case, but we have not yet had it from him."

In a subsequent letter they state—" The extract has a decided effect in one grain doses, and, in the hand of one medical man, was most effectual in checking the asthmatical paroxysm. In two cases, healthy individuals, in which we saw it administered, the effects produced were similar to those of opium but less exciting, and described as pleasing and peculiarly soothing." It is plainly mentioned, however, that whatever may be hereafter, its introduction into medical use is not now making progress, though a few trials with a better preparation of the drug than that which was at first submitted to medical gentlemen may do away their prepossession against it, and cause this medicine to be appreciated as it deserves.

Simple Processes for the detection of the Poisonous Compounds of Arsenic, Mercury, and Antimony, specially applicable to Toxicological cases occurring at Mofussil Stations. By HERBERT GIRAUD, M.D., *Professor of Chemistry and Materia Medica in the Grant Medical College, Bombay.*

In devising chemical methods for the detection of poisons, it is of the first importance to aim at as great a degree of simplicity in the processes, as may be consistent with accuracy, chiefly in order that the results may be uncomplicated by extraneous circumstances,—that unnecessary apparatus may be dispensed with,—and, above all, that those who

are unpractised in chemical manipulation may meet with as few difficulties as possible.

In this country duties of medical officers peculiarly remove them from the appliances requisite in toxicological research, and limit their opportunities of acquiring and maintaining that amount of practical skill on which, to so great an extent, depends the degree of importance attached to medical evidence in courts of law. So forcibly have these circumstances been experienced, that it is almost universally the practise with medical officers and magistrates at out-stations to forward to the Presidency, substances suspected to contain poison, for examination either by the coroner's surgeon,* or by some practised person possessing the requisite appliances. In Calcutta, the necessity of submitting all suspected substances to the examination of a properly qualified person has led to the appointment of an officer with the title of "Chemical Examiner," whose duty it is to investigate all toxicological cases referred to him, as well as to conduct other chemical researches in relation to soils, waters, and various natural productions: and there can be no doubt that, to promote the ends of justice, and to develope the resources of the country, it would be highly advantageous if there were such a chemical authority at each of the Presidencies.

Circumstances, however, frequently arise, which prevent the transmission of suspected substances to the Presidency; and cases not unfrequently occur in which, during their carriage, decomposition of the substances, favoured by the high temperature of a hot season, alters their condition, and gases become disengaged, which destroy the containing vessels.

Amongst many such cases that have come to my notice I may mention two in particular. The first was that of a medico-legal investigation, which was undertaken at Hydera-

* These, amongst other circumstances alluded to in this paper, refer chiefly to the Bombay Presidency.

bad in Scinde, in 1843, in which the medical officer called on to take up the case was unable to procure either the simplest kinds of apparatus or the most ordinary tests. The other was a case of suspected poisoning which occurred at Ahmedabad; from which station the suspected substances were dispatched by dâk to Bombay: the bottles were broken en route, the substances lost, and the case in consequence dismissed. Not unfrequently also, from inattention to certain precautions for placing the identity of a substance proved to contain poison beyond all doubt, the chain of legal evidence becomes broken, and it then requires but little ingenuity on the part of counsel to make a case break down in consequence.

In the hope of obviating such circumstances as the above, I have pointed out the following methods of simplifying the processes for the detection of the poisonous compounds of arsenic, mercury, and antimony: those of the two first under the form of white arsenic, orpiment, and realgar, and of corrosive sublimate being by far the most common, indeed almost the only, mineral poisons employed in this part of India.* In the course of my experiments I have succeeded in obtaining evidence of the existence of these poisons in organic mixtures by means so simple, as to require no other apparatus than the test tube, and to demand the least possible degree of skill on the part of the operator.

The possibility of withdrawing metals from their combinations by *substitution*, is now in constant application in chemical processes, but its superior advantages in the separation of the metallic base of a mineral poison for medico-legal purposes, was first pointed out by the German Chemist Reinsch,† whose method of separating arsenic from its solutions, in obedience to this principle, has been found to surpass every other in the three most essential points of an analytic

* The Bombay Presidency.

† Journal fur Praktíschen Chemic, 1842, xxiv. 242.

process; extreme simplicity, facility of execution, and absence of the sources of inaccuracy.

Reinsch's discovery consisted in this:—that arsenic may be separated from its solutions and deposited on copper leaf, when the solution, acidulated with hydrochloric acid, is boiled on that metal: and that, by gently heating the copper on which the arsenic is deposited, this latter is sublimed in the state either of arsenious acid or of metal, according to the quantity present. This discovery was made known at a time when Marsh's beautiful method of separating arsenic as arseniuret of hydrogen had been so refined upon, that, on the authority of M. M. Danger and Flandin, metallic deposits were said to have been produced when the arsenic formed only the 2,000,000th part of the liquid examined,* and yet the simplicity of Reinsch's process, and the more complete absence from it of sources of error, have given it a decided preference in the experience of every toxicologist of eminence. Dr. Christison, in particular, has expressed his confidence in Reinsch's process, and states that he has followed it "with great facility, certainty, and despatch, in several medico-legal cases;" that he has been able to detect at least the 250,000th part of arsenic in solution; and that it removes every particle of arsenic from the liquid, so that none could afterwards be detected by Marsh's method. Dr. Christison even goes so far as to say, that "it is not subject to any fallacy."†

A process of such simplicity is peculiarly adapted to the circumstances under which toxicological analysis frequently require to be undertaken in this country; and the object of my experiments has been to discover how far the same, or similar processes, might be employed in the detection of the soluble compounds of mercury and antimony.

Where the ordinary apparatus and appliances of a laboratory are at hand, Marsh's method, on account of its extreme

* Journal de Chimie Medicale, 1841, p. 413.

† Christison on Poisons, 4th Edit. p. 272.

delicacy, should never be neglected; but where such advantages are not within reach, a more simple process, even though slightly inferior in delicacy, must always be preferred. Hence, if in Reinsch's and Marsh's processes, the sources of error inseparable from each were exactly balanced, still Reinsch's method would be the one most generally applicable: for notwithstanding the improvements and simplifications introduced into Marsh's process by Drs. Fresenius and Von Babo,* by M. M. Flandin and Danger,† M. Blondlot,‡ M. Lassaigne,§ Berzelius, and others, still apparatus, peculiarly adapted to the processes, and of somewhat complicated construction, is required in every case; and whether the arseniuret of hydrogen be burnt in the open air as proposed in the first instance by Marsh, or in connection with a cooled receiver, as is practised by M. M. Danger and Flandin; or the gas be passed into a solution of nitrate of silver; or it be decomposed whilst passing through a tube heated to redness, as recommended by Berzelius and Liebig, still, in each instance, much practical tact, and some experience are requisite to ensure success. But the sources of error in Marsh's process do in reality far out-number those that can possibly enter into that of Reinsch. In the first place, any form of Marsh's apparatus having once had arseniuret of hydrogen evolved in it, can never again be employed with confidence, owing to the great difficulty, if not impossibility, of ridding the exit tube and stop-cock of all traces of arsenic. The objection, at one time so strongly urged against Marsh's method, on account of the supposed difficulty of separating and distinguishing arsenic from antimony deposited in this process from their respective hydrurets, need scarcely be alluded to, now that most simple methods of separating the two metals

* Annalen der Chimie und Pharmacie, 1844. xlix. 291.

† Journal de Chimie Medicale, 1841, p. 413.

‡ Comptes Rendus, July 1845.

§ Comptes Rendus, Dec. 1845.

have become so generally known. But a much more serious obstacle to the employment of the process in this country is implied in the fact that an arsenical sublimate may be obtained, and yet the arsenic be derived from other sources than the suspected liquid; for the zinc and sulphuric acid employed in the process, are both liable to be impregnated with arsenic, and hence become direct sources of error. The ores of zinc frequently contain orpiment, which, being reduced with the zinc, contaminates it with arsenic: Dr. Clark of Aberdeen has even stated that he has not discovered a single specimen of commercial zinc free from arsenic. Of late years iron pyrites has been much employed in the manufacture of oil of vitriol, and it occasionally contains traces of orpiment, by which the acid also is contaminated with arsenic. The difficulty of obtaining absolutely pure zinc and acid at an out-station, in a case of emergency, is sufficiently obvious. Re-distillation, both of the acid and zinc, can alone free them from this very objectionable impurity; and the means requisite for such a process are still less likely to be attainable at out-stations than Marsh's apparatus itself. The production of arseniuret of hydrogen by the galvanic decomposition of water, as suggested by Mr. Morton, excludes most effectually the presence of arsenic and other impurities from the materials employed: but such a method, by complicating the apparatus, could not be had recourse to in the circumstances just alluded to.

Such then being the advantages peculiarly adapting Reinsch's process to the detection of arsenic in cases of suspected poisoning occurring in this country; and it being the foundation of the methods I have adopted for the detection of the poisonous compounds of mercury and antimony, I shall briefly explain the most simple and effective manner in which it may be conducted, before passing to my own experiments.

Reinsch's Process.—Any particles, having the appearance of white arsenic, or of the grey fly powder, may be removed

from the matters to be examined; and either reduced to the metallic state by the ordinary methods, or be dissolved in boiling distilled water, and the solution tested in the usual way. But, if no evidence of the presence of arsenic be thus obtained, then all the soft solids should be cut in small pieces, and these, with the liquids, or with distilled water, should have pure hydrochloric acid added to them till it is decidedly in excess. The whole should then be boiled for an hour till all soft solids are either dissolved or broken down into fine flakes or grains: the mixture should then be strained through calico, brought to the boiling point, and, whilst boiling, pure copper turnings, copper leaf or wire should be introduced into it, and the boiling continued for about forty minutes; it being ascertained from time to time that there is an excess of acid. The copper is then to be removed, washed with distilled water, and dried. It is then found, if arsenic had been present, to have acquired a metallic coating of an iron-grey colour; or when the arsenic is in extremely small quantity, a violet or blue tint, somewhat similar to the colour of watch springs.* The copper thus coated with metallic arsenic is then to be introduced into a tube about the eighth of an inch in width, and heated by a spirit lamp, when a metallic sublimate will quickly be deposited in the cooler part of the tube. If, however, the quantity of arsenic be very minute, it is possible that it may be sublimed as white arsenic: and if the sublimation be performed in a wider tube (quarter or half inch,) the whole of the arsenic will be oxydized and deposited as arsenious acid. When this is the case, the copper being removed, the arsenious acid may be dissolved in distilled water, and subjected to the three most characteristic tests: the ammoniaco-nitrate of silver, the ammoniaco-sulphate of copper, and sulphuretted hydrogen.

* The following formula represents the decomposition effected by the copper:—

$$As\,O^3,\ 3\,H\,Cl,\ 3\,Cu. = 3\,Cu\,Cl,\ 3\,H\,O,\ As.$$

The only objections that can be urged against this process are, that arsenic may exist as an impurity in the hydrochloric acid employed; and that other metals, under similar circumstances, may be deposited upon copper, as I shall presently show is the case with mercury and antimony. In reply to the first objection it may be stated, that it is an extremely rare occurrence for hydrochloric acid to contain an arsenical impurity; and that, when it does, it may always be guarded against by boiling the copper in a portion of the acid before adding the suspected liquid. To the second objection it may be answered, that from no other metallic deposit whatever can a sublimate be obtained having properties which can possibly be mistaken for those of arsenious acid.

This simple method of Reinsch's has been generally applied to the detection of arsenious acid, but I have used it with equal facility and success in separating arsenic, existing as orpiment, from the contents of the stomach of a native woman who was found poisoned by orpiment administered to her by a native doctor, with the supposed intention of producing abortion. In this case, I separated the arsenic both in the metallic state and as arsenious acid, and to the latter successfully applied the three characteristic tests. This process also will succeed equally well with powdered arsenic, and with all oxydes and sulphurets of the metal.

The Poisonous compounds of Mercury.

Those causes which generally render the application of the more usual methods for the detection of arsenic difficult under the circumstances to which I have referred, equally affect the ordinary processes for determining the presence of the soluble poisonous compounds of mercury: but, fortunately, they may, with the same facility, be obviated by a process as simple as that of Reinsch for the separation of arsenic from its compounds.

Where the requisite means are at hand, and sufficient confidence can be placed in the experience of the operator,

Dr. Christison's method of separating mercury by the protochloride of tin must be regarded as yielding the most conclusive evidence of the existence of its soluble salts in mixed liquids: but as much practice is required in the use of this method; and as protochloride of tin is a substance which is used in this country only for chemical purposes; and moreover, is so liable to be decomposed by exposure to air, and converted into a basic salt, ($SnCl + SnO$) the objections to its use, under the circumstances alluded to, are sufficiently obvious.

The beautiful galvanic method invented by Dr. Wollaston, by which the mercury is deposited on gold, improved as it has been, by Mr. Sylvester and Dr. Paris,* and more recently rendered of such delicacy by M. Devergie,† that indications of mercury may be obtained where corrosive sublimate forms but an 80,000th of the solution, still does not recommend itself by such simplicity, nor does it include so many other advantages as the process I am about to describe.

Process.—Any soft solids existing in the suspected substances are to be broken down, and the whole, if not sufficiently fluid, must be well triturated with a little distilled water, and then strained through calico. The liquid is then to be acidulated with hydrochloric acid, raised to the boiling point, and pure copper turnings or wire immersed and boiled in it for about twenty minutes: the copper is then to be removed, washed with distilled water, and dried. If a soluble salt of mercury had been present, the copper will be found covered with a white coating of metallic mercury, varying in brightness with the quantity of mercury present. The coated copper turnings are then to be introduced into a tube of about a quarter of an inch bore, and heated by a spirit lamp, when a ring of metallic mercury, quickly running into glo-

* Medical Jurisprudence, ii. p. 208.

† Annales d'Hyg. Publ. et de Méd. Leg. xi. 411.

bules, will immediately be formed in the cooler part of the tube.

I have found, that by this process the $\frac{1}{256}$th of a grain of corrosive sublimate in thirty minims of water, gave a white metallic coating to copper turnings, and from them a ring of metallic mercury was sublimed, which, by a common pocket lens, was clearly seen to consist of globules.

Certain of the precautions necessary to be attended to in the application of the usual methods for detecting the presence of soluble salts of mercury in mixed liquids are also to be borne in mind in conducting this process. Thus, it is well known, that corrosive sublimate undergoes such changes in contact with organic matters as materially to alter the action of its ordinary tests. The researches of Orfila and M. Boullay have shown, that various vegetable and most animal fluids, extracts, fixed and volatile oils, and resins are capable of decomposing corrosive sublimate.*

Taddei, of Florence, has moreover shown the eminent degree in which this power is possessed by gluten,† and on the same property depends the well known antidotal powers of albumen and milk: and Christison has proved, that those changes may occur either at once, after a few hours, or not for some days.‡

Hence in the foregoing process it may occur, that these changes taking place before the substances are submitted to examination, the corrosive sublimate may be removed from the solution, and the insoluble mercurial compound, formed with the organic matters, be thus left upon the calico strainer,

* Annales de Chemie xliv. 176. According to M. Boullay, a part of the chlorine is disengaged in the form of hydrochloric acid; and the salt is consequently converted into calomel, which is deposited in a state of mixture or combination with vegetable matter.—Orfila Toxicol. Gen. i. 243.

† Taddei Recherches Sur un nouvel-antidote contre les sublimé corrosif.

‡ Christison on Poisons, 4th Edit. p. 381.

and in this manner escape decomposition by the copper. Hence, in every case, or at any rate whenever it is suspected that such changes have taken place under the influence of organic matters, it is better in the first instance to acidulate the substances with hydrochloric acid, and boil them with it for a quarter of an hour; by which means the organic mercurial compounds will be decomposed, and the corrosive sublimate restored: after this, all insoluble matters may be removed by straining through calico, the copper introduced, and the process proceeded with as above. On the other hand it must be remembered, that calomel (subchloride) is converted into corrosive sublimate (chloride) by being boiled with hydrochloric acid or an alkaline chloride, such as chloride of sodium. Thus I have found, that when a few grains of pure calomel were boiled for a quarter of an hour in a few ounces of soup, with its usual quantity of salt, corrosive sublimate could be detected in solution in considerable quantity; and when submitted to decomposition by the copper turnings, it gave an abundant deposit of metallic mercury in distinct globules: so that, if the possibility of such a transition from the insoluble to the soluble chloride be not kept in view, the previous existence of corrosive sublimate in a suspected substance may be inferred, when in truth it contained only calomel. Dr. Christison alludes to the difficulty likely to arise from the conversion of calomel into corrosive sublimate, in relation to other methods for the detection of mercurial poisons, and says, "that this objection can be obviated solely by sufficient evidence that calomel has not been administered."* When the soluble salts of mercury exist in considerable quantity, mercury will be deposited on copper from the acidulated liquid, without the aid of heat; and then the objection from the possible conversion of calomel into corrosive sublimate will be entirely obviated.

* Christison on Poisons, 4th Edit. p. 386.

It may be objected, that the process I have described proves only the presence of mercury, and does not show the state of combination in which it has existed. This objection, however, applies to every process for the detection of mercurial poisons, with the exception of Christison's method by ether, which in other respects, however, is too fallacious to be depended on.* A medical jurist therefore can seldom do more than prove the existence of mercury; and, with the precautions I have pointed out, the above process is capable of proving that it existed in some soluble form; and the only common soluble salts of this metal—viz. corrosive sublimate and the nitrate are both highly poisonous. Whether the substance had acted as a poison or not, would be determined by the symptoms, and in the case of a person dying under the symptoms of mercurial poisoning, it would in general be sufficient to show that mercury was present in the viscera.

By the foregoing process the quantitative estimation of the corrosive sublimate may easily be effected. By introducing successive portions of copper into the liquid till no further deposits of mercury occur, the whole of the mercury may be separated, sublimed, and weighed, and thus the amount of corrosive sublimate present be estimated, as from its composition every 100 grs. of mercury obtained, indicate that 135 grs. of crystallized corrosive sublimate have been present.

In September 1844, I had an opportunity of applying the foregoing process for the detection of corrosive sublimate in a case of attempted poisoning.

An European servant in a family in Bombay perceived something unusual in the taste of her tea, and found that a silver spoon with which it had been stirred was turned almost black wherever the tea had touched it. It being conjectured, that some deleterious substance had been introduced into the

* Christison on Poisons, 4th Edit. p. 383.

tea for a criminal purpose, it was placed in a bottle with the spoon immersed in it, and sent to me for analysis. There was a light brown deposit of insoluble matter in the bottle, most probably produced by the decomposition of part of the corrosive sublimate by the tea and milk; but on pouring off the clearer portion, and submitting it to the foregoing process, abundant rings of metallic mercury in globules were obtained by sublimation from the copper which had been boiled in the acidulated liquid. Wollaston's galvanic test gave mercurial deposits on gold, and the ordinary liquid tests afforded corroborative evidence of the existence of a soluble salt of mercury.

The Poisonous compounds of Antimony.

Cases of poisoning with antimonial compounds are very unfrequent in Europe, and are still less liable to occur in this country. It is the possibility of tartar emetic being accidentally taken in poisonous doses, that chiefly renders it important to be prepared with the means of detecting the presence of antimony in organic mixtures.

It is well known with what accuracy Marsh's process may be applied to the separation of antimony from mixed liquids; and that it is scarcely less inferior in delicacy in its application to the decomposition of antimonial than of arsenical compounds. But the same obstacles that preclude the general use of this delicate method in the case of arsenic, occur equally in that of antimony.

The method also devised by Turner and Orfila, and recommended by Christison, for separating the antimony as sulphuret, and then reducing that compound by means of hydrogen gas, is equally inapplicable to emergent cases occurring in this country, on account both of the peculiarly constructed apparatus required, and of the difficulties attendant on the process.

The simplicity of the following method, and the ease with which it may be conducted, peculiarly recommend it under

those circumstances in which a supply of apparatus is not procurable, and the operator has little reliance on his own skill and experience.

Process.—Any soft solids existing in the mixture having been broken down, as in the process for arsenic and mercury, and the whole brought to a proper degree of liquidity by distilled water, it is to be thrown upon a calico strainer, and hydrochloric acid added in excess to the clear liquid,* which is then to be raised to the boiling point, pure copper turnings introduced, and the whole boiled for a quarter of an hour.

The copper is then to be removed, washed with distilled water, and dried. If antimony had been present, the copper will be found covered with a grey deposit, scarcely distinguishable from that of arsenic, and like it, having a violet hue when in extremely minute quantity. The coated copper is then to be introduced into one end of a tube of about one-third of an inch bore, five or six inches long, and open at both ends. The copper is then to be raised to a full red-heat by means of a spirit lamp, and the tube inclined at an angle of about eighty degrees, the empty end being raised, so that a current of air may be drawn over the heated metals: the tube should be kept in this position for a quarter of an hour, when it will be found that the antimony has become oxydized, and that, at a distance of a few lines above the copper, a deposit of white oxyde of antimony has been formed. The portion of the tube containing the oxyde may then be filed off, and boiled in a solution of tartaric acid, by which the oxyde will be dissolved out. To the solution thus formed, the liquid tests for antimony may be applied, and the charac-

* The addition of hydrochloric acid to the antimonial solution is generally followed by a precipitation of the white oxychloride ($Sb\ Cl^3 + 3\ Sb\ O^3$) *Berzelius.* This change, however, does not interfere with the success of the process, as this precipitate is completely decomposed by the copper.

teristic sulphuret thrown down by sulphuretted hydrogen.* If sulphuretted hydrogen be passed through the tube in which the oxyde of antimony has been deposited, the sulphuret will at once be formed and recognised by its orange-red colour; but however distinctive this may be, it will be found much preferable to obtain a solution of the oxyde as above recommended, from which the other characteristic reactions of antimony may be obtained.

By the above process, I have been able to procure a sublimate of the oxyde of antimony from $\frac{1}{64}$th of a grain of tartar emetic dissolved in one drachm of distilled water; indicating a degree of delicacy in the process much greater than could be essentially requisite in any medico-legal case whatever.

All methods for the detection of antimony, equally with those for mercury, and the above process in common with others, serve only to prove the existence of the metal in some state of combination possessed of solubility, and do not point out what the particular combination is. But in the case of antimony, this circumstance is of still less importance than in that of mercury; as tartar emetic is the only salt of the oxyde of antimony, in a soluble form, which is likely to become the subject of inquiry.

General Remarks on the foregoing Processes.

It will be found on comparing the three foregoing processes, that the principle on which they are founded is the same in all of them. In each there is effected a metallic deposition on copper; but in the case of arsenic the metal is readily oxydised at a moderately elevated temperature; in that of mercury, the pure metal is sublimed in the characteristic state of liquid globules; and in that of antimony the oxyde is formed

* It is better, if possible, to make use of a tube of hard German glass, both because it sustains the requisite degree of heat better, and is also free from lead, which is apt to be separated from the common kinds of glass, and thus to contaminate the oxyde of antimony; and in this way interfere with the appearances afforded by sulphuretted hydrogen.

only when the metal is subjected to a full red-heat in a current of air.

The peculiar advantage of these methods is, that under circumstances in which tests and apparatus cannot be procured, the first stage of the processes alone may be performed: the copper may be boiled in the acidulated liquids, and should a metallic coating be deposited upon it, it may be preserved unaltered for any length of time, and in this convenient form the poison may be transmitted to the Presidency for final examination.

On Delirium Tremens. By W. A. Green, *Esq., Bengal Medical Service.*

The treatment of Delirium Tremens, in severe and protracted cases more particularly, is yet even, occasionally, a matter of difficulty and doubt. With this view I have collected together the results of my experience scattered over several years, in the present record of a few cases, adding the pathological condition of the brain observed in four instances where death closed the disease.

The difficulty of the treatment and the danger of the prognosis are greater in the cases of confirmed drunkards than where the disease occurs in younger and less practised drinkers. When the disease occurs in the comparatively healthy, and is presented to the physician in the state of excitement immediately following large potations, when, from the heat of skin, forcible pulse, and high excitement, the disease approaches nearly to meningitis and encephalitis, the case generally yields to depletion by active purgatives, vesicatories and rubefacients and the application of cold to the accelerated circulation of the brain, followed by opium in repeated doses, or opium combined with tartar emetic, given to soothe and tranquillize the irritated brain and nerves. In another kind of cases alluded to above, the treatment is not so clear and smooth, where the case is first seen many hours after the withdrawal of the excessive, perhaps long continued, stimulus, and after the subsidence of the first stage of excite-

ment, the skin perspiring, often damp, the pulse rapid, tremor present with delirium, (although, the capacity of rational reply remains) now and then convulsive movements, perhaps cramps in the legs, sleeplessness, often continued vomiting, and dull congested features, and in the midst of these symptoms the delirium often becoming violent and maniacal. In such cases we have to contend against cerebral irritation and congestion, and the tendency to effusion. We give aperients with calomel, set up counter-irritation, support the exhausted vital and nervous energies by a moderate portion of the wonted stimulus, and endeavour to allay the excitement and irritation by repeated doses of opium. In the use of the opium, I consider the exercise of tact and discrimination necessary, lest we thereby add to the cerebral congestion and favour the process of effusion. As connected with this subject, and with the consideration of cerebral disease generally, it is worthy of remark how numerous and various the diseases of the brain, and the lesions of sense and sensibility, in which, nevertheless, the post mortem appearances shew shades of difference merely, such as a little more or less congestion and turgescence of the veins and sinuses, and choroid plexus, more or less arachnitis and injection of the pia mater, more or less effusion upon the superficies, at the base of, and within the brain. This observation holds good in fever in its different types ; in the state of cerebral congestion, often lingering, and accompanied by typhoid symptoms, the sequence of cholera; in coup de soleil and apoplexy ; in delirium tremens ; in meningitis ; in acute mania. So that we are led, I think, to attribute the variety in the symptoms to something peculiar in the several effects of the various noxious causes, as well as to the morbid structural changes going on, which are observed after death—for from the bare pathological condition, and when guided by experience too, we are not able to read off and determine the individual character of the disease in these different cases. I am speaking generally, allowing at the same time that, in many instances, a particular set of cerebral symptoms points out to, and is afterwards elucidated by, the discovery of some important

lesion of the cerebral substance, or some specially localized inflammation of the membranes. All the usually assigned causes of the above enumerated diseases may each have its peculiar modifying effect in giving a stamp to the symptoms :—in fever, the malaria or particular status of the atmosphere; in cholera, as it rages epidemically, some subtle poison derived from the suddenly altered constitution of the air, the inappreciable and inscrutable effect of a thousand unknown agencies—this poison entering into the blood, vitiating the vital fluid, and rendering its circulation through the brain, and elsewhere, incompatible with life; in coup de soleil, the ardent rays of the sun, and the increased temperature of a heated atmosphere, giving to the patient, in the early stage, the sensation of molten lead ramifying through his brain; in delirium tremens, and the apoplexy of deep drinking, the particular vinous stimulus; in mania and phrenitis, their own particular exciting causes, diversified as they may be.

Synopsis of history and treatment of Eleven severe successful, Three slight, and Four fatal cases of Delirium Tremens.

Number of days ill before treatment, on an average of 18 cases,—2½ days.	Number of days after treatment discharged well, on an average of 14 cases,—9 days.	Number of days after which the disease yielded as to severity, on an average of 11 cases,—3½ days.

In 11 severe cases the disease yielded :—

No. 1 on 4th day after administering	Tinct. Opii. ʒiij.
2 on 7th day	Opii. gr. ij. Morphiæ Muriat. gr. 13.
3 on 6th day	Morphiæ gr. 9½.
4 on 6th day	Tinct. Opii. ʒvij ss.
5 on 2nd day	Tinct. Opii. ʒiv.
6 on 2nd day	Tinct. Opii. ℥j.
7 on 2nd day	Tinct. Opii. ℥j.
8 on 6th day	Tinct. Opii. ʒvij.
9 on 2nd day	Opii. gr. i. Morphiæ gr. 1¼.
10 on 4th day	Opii. gr. ij. c. calomel ℈ij. Tinct. Opii. ʒiss. c. Antm. potass. tart.
11 on 6th day	Tinct. Opii. ʒxvss. c. Antm. potass. tart. Morph. Mur. gr. ij.

In 4 fatal cases there were administered:—

No. 1. Complicated with Pneumonia—Tinct. Opii. ʒxii in 2 days—death on 6th day.

No. 2. Complicated with Dysentery—Opii. gr. 3½ with calomel in 2 days—death on 3rd day.

No. 3. In an habitual drunkard for many months—Tinct. Opii. ʒvj during a day and night—death on 3rd morning.

No. 4. In an habitual drunkard—Tinct. Opii. ʒxij nearly, during 3 days and nights—death on 4th morning.

Ages, ...	20 to 30	30 to 40	40 to 50		
Recovered, ...	5	6	3	=	14
Died, ...	2	2	0	=	4
Total,......	7	8	3		18

Cases occurring for the most part in Seamen.

No. 1. Nov. 13th, age 39.—Is a drunkard; has been on shore for several days; attacked by the disease in the forenoon.

General Symptoms.—Heat and pain in head; vascular turgid eyes; general tremor and agitation; quick, small, compressible pulse; epigastrium painful; green vomiting; dry furred tongue. Diarrhœa—well in 8 days; this man was readmitted with the same disease after 2 months.

Treatment.

No. 1. Leeches Epigastr. Cal: ℈j. Opii: gr. i. Jalap. Cal: ℈j. Blister Epigastr. Dover's powder and blue pill; Ol: Ricini. Dover's powder.

No. 2. Nov. 13th, age 24.—Drinking yesterday, and for several days previously; taken ill today.

General Symptoms.—A little pain in the head, weight of head, sleepiness, giddiness, stuffing of the ears; tremulous, agitated tongue and manner; perspiring skin; small feeble pulse; red-edged tongue; weight at epigastrium; occasionally cramps of legs—well in 6 days.

No. 2. Sinapism Abdom: Calomel ℈j. Extract Coloc: c. gr. x. Opii: gr. ij. Jalap postea. Blue pill. Dover's powder 4 tis. hor: Jalap p. r. n.

No. 3. Nov. 23rd, age 21.—Has been drinking on shore 3 or 4 days ago.

General Symptoms.—Tremor; agitated manner and speech; no head-ache; wanders in his mind and starts as he lies; cannot sleep quietly; quick, small, weak pulse; warm perspiring skin; tongue furred, moist. Diarrhœa—well in 7 days.

No. 3. Calomel ℈j. with Dover's powder. Tinct: Opii: c. Antim. Potass: Tart: in repeated small doses for 3 days. Calomel ℈j. Opii: gr. i. Ol: Ricini gums became sore.

No. 4. Jan. 7th, age 24.—Taken ill 4 days ago after hard drinking on shore.

General Symptoms.—Low spirits, the state called "the horrors;" palpitation of the heart; small, weak, slow pulse; giddiness; on the 3rd day violent and deranged. Relieved after the 3rd day—evident relief was afforded in this case by the large doses of laudanum.

No. 4. 1st day—a purgative. Tinct: Opii: ʒj.

2nd day—has slept after the Tinct: Opii: lies quiet to-day—to take Dover's powder and blue pill twice.

3rd day—Tinct: Opii: ʒij.

No. 5. Jan. 12th, age 39.—Vide case No. 1. An habitual drunkard—2 days previously to admission was treated on board-ship for pneumonia, and bled—has been drinking, and the delirium tremens has supervened upon the latent pneumonia.

1st day—delirious on admission; heat and slight pain of head; quick, small feeble pulse; religious ravings, but replies to questions.

Night — delirious, running about the Hospital, with a pale tongue.

2nd morning—red eyes, small feeble pulse.

4 o'clock P. M.—has been delirious all day.

3rd morning—sleep with stertor; stools in bed; cold extremities; fixed contracted pupils; at times low delirium.

1 o'clock P. M.—convulsive twitches as he lies, but replies to questions.

No. 5. 1st day—on admission Tr: Opii: ʒj. after a few hours Tr: Opii: ʒij.

Night—Tr: Opii: ʒiij.

2nd morning—Tr: Opii: ʒij.

4 o'clock P. M.—Tr: Opii: ʒij to be taken twice.

3rd morning—to have brandy.

1 o'clock P. M.—Sinapisms, Calomel gr. x. Hirud: Tempor: effervescing draughts.

6 o'clock P. M.—Calomel gr. x.

4th day—Magnes: Sulph: ʒij terdie—evening Hirud: xij. Tempor.

5th and 6th days—Sinapisms to different parts of the body—blister to chest. Antim: Potass: Tart: c. Tr: Opii: repeatedly: an occasional æther draught.

Post Mortem Examination.

Head.—A congested gorged state of the longitudinal sinus and veins upon the surface of the

6 o'clock P.M.—hot skin; feels giddy; lies dozing with his eyes closed; subsultus tend; picking at bed clothes; vomiting; feculent stools.

4th day—hot skin; pallid dry gums; feeble pulse; replies but soon relapses into moaning and stupor.

5th day—pulmonic symptoms developed with a relief of the delirium and cerebral oppression.

6th day—oppressed, rattling respiration; dry tongue; thick yellow mucous sputa—death. In this case the laudanum did not reduce the delirium, nor produce sleep, but rather stupor. The disease of the lungs of course maintained and kept up the cerebral disease.

No. 6. April 12th, age 36.—Was drunk yesterday.

Symptoms.—Tremor, low spirits—he felt well in 4 days.

No. 7. July 20th, age 39.—A great drinker, has been drinking for the last 4 days; before admission had convulsive fits with rigidity of the limbs.

General Symptoms. — Dark congested expression of features; head-ache not complained of; feels tipsy; pale lurid tongue; quick feeble pulse; totters as he walks; timid, tremulous, agitated manner; mind disturbed; want of quiet sleep: as the disease advanced, subsultus tendinum, disposition to coma; contracted yet moving, pupils; delirious laugh; his replies less rational; evacuations healthy.

6th morning—has been delirious during the night running about; wild manner and look; his gums are sore.

brain; an injected state of the pia mater; effusion of serum beneath the arachnoid, into its bag, and within the ventricles of the brain; milkiness of the arachnoid.

Chest.—Extensive inflammation and consolidation of the lungs.

No. 6. Antim: Potass: Tart: gr. i. c. Tr: Opii: ʒss. divided into 6 doses—to take repeated doses of this strength.

No. 7. 1st day—Calomel gr. x. Opii: gr. ij. St: Morph: Mur: gr. ij. divided into 3 doses during the day.

2nd day—Morphia gr. i. ter.

3rd day—Morphia gr. ss. quater—a dose of Calomel and Colocynth twice. Mercurial inunction.

4th day—Morphia gr. ss. bis. Calomel ℈j.

5th day—Calomel and Colocynth twice.

6th day—Morphia gr. v. divided into 4 doses during the day—besides this treatment, several blisters and sinapisms were applied, ice to the head, pediluvium, repeated turpentine enemata.

7th morning—has been delirious all night, and quite deranged; now lies comatose and convulsed; incoherent when disturbed.

8th morning—sleep with snoring in the night. Evening—has slept to-day, at the same time convulsed.

10th day—muttering and picking during sleep; is rational; gums ulcerated. During the next 12 days the tremor, convulsive twitchings, and temporary incoherence became mitigated—he was rational at times; evacuations healthy; skin clammy; pulse small and quick. Just before he quitted Hospital he had a relapse of coma, but recovered at sea. He left Hospital on the 22nd day for sea.

7th day and onwards—the treatment consisted of repeated aperient doses, small doses of Antim: Potass: Tart: c. Tr: Opii: blisters and turpentine enemata; latterly he took Quinine, and doses of Camphor and Hyosciamus.

No. 7. The morphia given in this case did not seem to allay the cerebral disturbance and delirium, but rather to increase the convulsive movements and tendency to coma. The Antim: Potass: Tart: c. Tr: Opii: lessened the delirium, and procured a little sleep.

Note.—I have heard from Dr. J. Macpherson, of the General Hospital, of a case of Delirium Tremens recently presented to him, in which the man fell down in a fit as if apoplectic, in which, after death, the only morbid appearances were red points in the brain, and effusion to a very small extent.

No. 8. July 22nd, age 40.—Has been drinking for 3 days; taken ill to-day; he fell down on board-ship to-day as if in a fit of apoplectic.

General Symptoms.—After admission, no pain in head; tremor and agitation recurring with increased severity in paroxysms, and, when spoken to, articulation impeded; is quite sensible; dry furred tongue; warm moist skin; quick, small, weak pulse, evacuations good.

No. 8. 1st day—morning Morph: Mur: gr. ij. afternoon Morphia gr. ss.

2nd morning—Morphia gr. i. afternoon; Morphia gr. ss. bis. c. Calomel gr. iij. bis. Evening rep. Morphia c. Calomel bis.

3rd day—an aperient Pil: Hydrarg: c. Colocynth.

4th day—Morphia gr. ss. ter. c. Calomel gr. iij.

5th day—Morphia gr. i. bis.—besides this treatment a blister was applied to the neck on the

Sleep obtained on the 2nd night, and again on the 4th and 5th nights; gums sore on the 4th day; the disease subsided on the 6th day—he was well on the 11th day.	first day, and several turpentine enemata during the time. 7th day—Quinine was given.
No. 9. Oct. 16th, age 34.—A confirmed drunkard; drunk just before admission. *General Symptoms.*—Headache; vomiting; has the horrors; is deranged in his mind; feels stunned—these last symptoms, slight at first, increased much on the 3rd evening.	No. 9. But little treatment at first.
3rd evening—tremor; delirium; quick, weak pulse; warm, perspiring skin; loaded, moist tongue. 4th evening—he got out into the grounds, trembling and delirious.	3rd evening—Tinct: Opii: ʒj. quater.
5th day—raving all last night, is violent to-day.	5th morning—Tinct: Opii: ʒj. quater.
6th morning—raving all night. Evening—has replied sensibly to-day and been inclined to sleep.	6th morning—Tr: Opii: M. v. Antim, Potass Tart: gr. $\frac{1}{4}$ 2 dis. hor. besides this treatment a blister to the neck, turpentine enemata.
7th morning—has slept all night. The disease yielded to the opium on the 6th day. He was discharged well 16 days after admission.	7th day—Saline aperients.
No. 10. Dec. 20th, age 38.—Has been drinking four days. *Symptoms.*—Suffered from the horrors for the 2 first days after admission with vomiting and looseness, feeling weak and sick. He was relieved of the mental hallucination and distress in the course of the 2nd day. Discharged well in 4 days. The large dose of opium afforded marked relief.	No. 10. 1st day—Tinct: Opii: ʒij. bis.
No. 11. Jan. 3rd, age 40.—Disease of 4 days old; assumed its height 4 days after an excess committed in drinking.	No. 11. 1st day—Tinct: Opii: ʒij. bis.

Symptoms.—1st day is delirious, tremulous, has head-ache; quick, weak pulse.

2nd day—has been deranged all night.

2nd day—Tinct: Opii: ʒij. bis.

3rd day—delirum has subsided, is tremulous, has head-ache; heated skin; after this, giddiness and weakness of limbs remained for several days.

3rd day—aperients.

4th day—Camphor gr. iv. Extr: Hyosciamus. gr. iv. ter. die.

5th day—aperients.

7th day—a blister nuchæ.

The delirium subsided after the 2nd day's doses of Tinct: Opii. Discharged well after 12 days.

No. 12. Feb. 13th, age 48.—Delirium tremens of 6 days before admission, following upon hard drinking; he has been raving on board ship for several nights before admission; was violent the night previously to his admission.

No. 12. 1st day—Tinct: Opii: ʒij. 4 times during the day.

1st morning.

2nd morning—has been violent in the night, is incoherent now.

2nd morning—aperients.

Evening—has been quiet all day.

3rd morning—has been quiet all night.

3rd morning—saline aperients.

He was relieved of his delirium on the 2nd day, after the large doses of laudanum. Discharged well after 14 days.

No. 13. May 3rd, age 30.—Ill for 3 days before admission; has felt his head heated and painful for a longer time; has had cause for mental excitement on board ship; has been exposed to the sun, and drinking.

No. 13. 1st night—Calomel gr. x. Extr: Hyosciamus gr. iv. blister nuchæ.

General Symptoms.—On admission, quiet pulse; clammy perspiring skin; tongue loaded, white pale; tremor; giddiness; agitation of manner.

2nd morning—walking about all night in a wild state; heat and pain of head; quick, weak

2nd day—repeated small doses of tartar emetic and laudanum.

pulse; tremulous tongue; bowels open.

3rd morning—better; has slept.

Evening—has returned to the Hospital with noises in his ears; agitated tremulous manner (he was necessarily allowed to leave the Hospital for a few hours.)

Night—quite deranged; skin clammy.

3rd day—repeat medicine: afternoon—Tinct: Opii: ʒij.

4th morning—has been deranged all night; kneeling, and confessing, and writing letters, with lucid intervals at times; face flushed this morning; heated perspiring skin; pale tongue; agitated manner.

Noon—skin heated; perspiring.

4th morning—Tinct: Opii: ʒij: afternoon—Tinct: Opii: ʒij. a glass of beer to-day.

5th morning—has slept nearly all night, although wild at times.

Evening—quiet during the day.

6th morning—has been quiet all night. He left Hospital to-day, and although remaining queer and odd in manner, he shortly afterwards took down his ship.

5th day—a glass of beer, besides this treatment he had on a second blister, sinapisms, and took aperients.

No. 14. July 29th, age 23.—Has been drinking hard the day before admission, and slept on deck the same night.

General Symptoms.—Continual vomiting of greenish liquid for 24 hours after admission; tremor of tongue and body generally, increased in paroxysms; manner agitated; feels giddy, nauseated, and faint; weak pulse; perspiring skin; tongue thickly coated, yellowish-brown; experiences flushes of heat at times; he is able to sleep a little.

2nd day—towards the afternoon, all his symptoms much relieved after free evacuations. He left Hospital after 5 days.

No. 14. 1st morning—Calomel ℈j. Opii: gr. i. Afternoon—Morph: Mur: gr. $\frac{1}{4}$ terdie with calomel gr. iij. Night—Morphia gr. $\frac{1}{2}$, besides, a warm bath; purgative enemata.

No. 15. April 25th, age 25.—Is a drunkard; is said to have had dysentery for several days before admission, and to have taken a large quantity of liquor since yesterday; admitted in a state of insensibility, with tremor of the muscles of the face.

General Symptoms.—1st day, lies in a state of stupor; mutters unintelligibly when questioned; contracted pupils; pallid countenance; perspiring brow; convulsive tremor of face; jaws fixed; thready pulse; tumid, tender abdomen; shrinks under pressure at left iliac region.

2nd morning—delirious in night, left his bed; now in a state of stupor; skin warm, perspiring.

1 o'clock P. M.—bowels open; has passed scybala; stupor; heat of head.

Evening—stupor; eyelid closed; moaning; jactitation; quick, small, weak pulse; a damp surface.

3rd morning—still takes medicine; state much the same. Sinking: died at 11 o'clock A. M.

No. 15. 1st night—Calomel gr. iij. Opii: gr. i. 4 tis. hor. blister to abdomen, sinapisms.

2nd morning—has taken 3 doses of medicine; Jalap ʒj. st. Enema: Purg: postea, blister nuchæ.

1 o'clock P. M.—Calomel gr. iij. Opii: gr. $\frac{1}{4}$ st. et 3 tis. hor. sinapisms again, cupping on the temples to ℥ 2 or 3.

Evening—has taken one dose only of medicine, Enema Purg: another blister nuchæ.

Night—ammonia and quinine.

3rd morning—ammonia, brandy, &c.

Post Mortem Examination four hours after death.

Head.—An injected state of the feeding veins of the sinuses, and of the vessels of the pia mater, but not to a great extent; fluid effused within the bag of the arachnoid; a dram or two of serum within each ventricle; brain naturally firm. Blood vessels at the base of the brain injected.

Intestines.—The mucous membrane of the whole of the large bowels of a deep purple and highly congested appearance. Mesentery glands much enlarged and extra vascular,—contents of bowels bilious and mucous matter of different colours.

No. 16. June, age 25.—Has been drinking for days, previously to admission; is a confirmed drunkard; has been treated for delirium tremens outside during the last few days—has been drinking hard just before admission; the delirium has increased in severity.

Symptoms.—Incoherence; tremor; heated skin; rapid pulse.

2nd morning—no sleep in night; has fallen down and cut

No. 16. 1st evening—Tinct: Opii: ʒj. 2 dis. hor. for six times, if the symptoms be not abated—sinapism all along spine.

2nd Morning—(has taken six doses of Tinct: Opii:) Calomel

his head, upon attempting to get out of bed; spoke rationally this morning at 7 o'clock A. M., since which he has been lying in a state of stupor, muttering; subsultus tendinum; pupils contracted; face livid; skin and head hot; rapid pulse.

3rd morning—died at 3 o'clock A. M.

and Jalap; turpentine enemata; ice and cold effusion upon head; blister upon head; repeat sinapisms, pediluvium, &c.

Post Mortem Examination nine hours after death.

Head.—Dark blood poured out very largely from the divided scalp during the process of opening the head; effusion upon the superior surface of the brain, within the cavity of the arachnoid; three ounces of serum altogether found at the base and within the ventricles. Milkiness and thickening of the arachnoid membrane superiorly. Vessels of the brain congested; an apoplectic cell filled with coagula of the size of a Spanish nut, at the inferior part and right side of the anterior lobes.

No. 17. July, age 38.—Engineer of a steamer; a constantly hard drinker; has had delirium tremens since 2 o'clock P. M. of yesterday.

Symptoms.—Great tremor; incoherent manner; impaired articulation; moist, cool skin; full pulse; parched mouth; vomiting; tender epigastrium; palpitation.

1st evening—has slept.

No. 17. 1st day—effervescing draught with Tinct: Opii: M. xx. 2 dis. hor. until sleep: evening—has had five doses, (vomiting now and then) repeat the medicine twice.

2nd morning—much the same; short periods of sleep only; perspiring skin; vomiting: evening—incoherent and wild; wandering about the room; bounding irritable pulse; perspires freely.

2d morning—a purging draught, c. Tinct: Opii: M. xx. ice to head, sinapisms abdom.

Evening and night—Tinct: Opii: ʒj. Omn: hor. to seven times.

3rd morning—has remained much the same all night, and is so now: evening—has become very violent; talking deliriously, so that, in the absence of the proper means of control, it has been necessary, for the safety of the sick in Hospital, to use constraint by tying his arms and

3rd morning—Calomel and Jalap, blister nuchæ; repeated small does of tartar emetic and laudanum.

Evening—Tr: Opii: ʒj. Omn: hor. a little brandy and water, (he refused the laudanum several times.)

Night.—blister to vertex.

legs; pulse rapid and small; contracted pupil; skin perspiring profusely; the constraint caused him to struggle for release; great thirst.

Night—has become quiet; has convulsive movements of hands: midnight—is violent again.

4th morning—is quiet now; the fastenings have been loosened; stupor with heavy breathing; occasional muttering; subsultus tendinum; pupils contracted, inactive; clammy skin; rapid, weak pulse; pallid tongue; tumid belly —10 o'clock A. M. died.

The laudanum in this case, as also in the case No. 16, appeared to be of no service.

4th morning—Calomel and Jalap; several turpentine enemata; sinapisms to legs; brandy and water.

Post Mortem Examination three hours after death.

During the opening of the head several ounces of dark blood escaped from vessels of the scalp and from within the skull; a considerable effusion of serum within the arachnoid upon the superior surface of the brain; the arachnoid milky, its two layers adherent along the sides of the longitudinal sinus; serum beneath the arachnoid raising it from the pia mater. The minute ramifications of the vessels of the pia mater, both on the surface and between the convolutions, highly injected; numerous bloody points upon dividing the cerebral substance; more than two ounces of serum at the base of the brain, within the ventricles and issuing from the spinal canal; choroid plexus much congested.

Chest.—Heart an atheromalous condition of inner layer of arch of aorta. Lungs loaded with blood. *Abdomen*—stomach, a highly injected state of mucous membrane of great end: liver, maculated externally, red and yellow, its texture, upon division, of a nutmeg appearance, firmer and more brittle than usual; treacly bile in gall bladder.

No. 18. August, age 28.—A hard drinker—*History.* Says he has been vomiting continually for the last three days; denies having committed excess; he has, however, upon other occasions been seen in liquor; the vessel has just arrived from sea; on ad-

No. 18.—During the first three days he had repeated effervescing draughts with Tr: Opii: M. xv. in each; a sinapism abdom: a dose of laudanum each night, which was given twice on the 2nd night; Mist: Sennæ: Comp: on the 3rd morning.

mission, and for the first three days he exhibited the following slight symptoms, viz., vomiting, (which was moderated after a few hours); slight tremor; an uneasy, starting manner; starts up alarmed out of his sleep which is very short; skin cool; disposition to costiveness.

3rd day, 2 o'clock P. M.—became incoherent in his manner and ideas; imagining violence used towards him; warm, perspiring skin; rapid, round pulse; 3 stools to-day.

3rd day, 2 o'clock P. M.—Tinct: Opii: M. xx. Omn: hor. (3 doses) sinapism, brandy ʒj. every hour three times.

5 o'clock P. M.—is sobbing; agitated; replies sensibly to some questions.

5 o'clock P. M.—Antim: Potass: Tart: gr. $\frac{1}{4}$ Tinct: Opii: M. xv. Om: hor. 5 doses.

Night—says he has pain across the brow; pupils contracted; is now wild and incoherent; defending himself from fancied attacks; starting up from his bed and running about the room; is continually catching at objects in the air; he submits to authority; refuses nourishment; no sleep; pulse and skin the same.

Night.—Antim: Potass: Tart: gr. $\frac{1}{2}$ Tr: Opii: ʒss. Omn: hor. 5 doses. Emplastr: lyttæ nuchæ. Sp: Ammon: Arom: once or twice in night, another ℥j. of brandy.

4th morning—in a low state; wet skin; pale, white, dry tongue; several coffee-like stools; incoherent and obstreperous all night; conjunctivæ vascular.

4th morning—Comp: Jalap ʒj. Tinct: Opii: ʒj. to be repeated in 2 hours.

3 o'clock P. M.—head and surface generally heated; is quite delirious; in a very agitated state, and alarmed, fancying his legs have become enormously enlarged, and is constantly rubbing them.

3 o'clock P. M.—Antim: Potass: Tart: gr. $\frac{1}{8}$ Tr: Opii: M. x. Omn: hor. 4 doses; ice to head. Brandy ℥iv. with water during the day and night.

Night—warm perspiring skin; rapid pulse; the same wandering about, and incoherent talking; complete restlessness and want of sleep.

4th night—Tinct: Opii: ʒj. three doses.

5th morning—in the same violent state all night; general state much the same; has tremor and subsultus tendinum; no action of

5th morning—turpentine Enemata (twice), Tinct: Opii: ʒj. 2 dis. hor. (three doses). Brandy ℥ii. in the day.

the bowels; replies rationally to questions put to him, although he otherwise exhibits the same incoherence as before; he denies head-ache.

5 o'clock P. M.—since the morning visit he has slept $2\frac{1}{2}$ hours; is sleeping lightly now.

Night—sleeping, subsultus tendinum of face and extremities.

6th morning—has slept a good deal during the night; is quite rational; pupils act freely; pallid tongue; vomits very much—during the next 4 days, (at the end of which he was discharged) he gradually became more tranquil and composed in his manner; regaining his power of correct association of ideas; sleeping naturally; regaining strength and appetite; losing to a great extent the convulsive twitchings, and tremulous hurried manner. Discharged well on the 11th day. The laudanum in this case, by at last inducing sleep, was most markedly efficacious.

6th morning—Enema purgans, Brandy ℥j. in the day.

Evening—Mist: Camphor c. Tr: Opii: M. v. bis.

7th—Saline Sudorific draught c. Tr: Hyosciam: M. xii. 4 tis. hor.

Evening—Morph: Mur: gr. j. to be taken divided into 3 doses: takes soup: brandy omitted.

8th—Pursued the same treatment, Ol: Ricini ℥ vj.

11th day after admission—Discharged well.

Extract of a letter from J. NIMMO, *Esq., Bombay, dated Colaba, 29th August,* 1846.

"Among the fishes of our seas here, I have often seen a species of Torpedo, with rudiments of toes or rather feet, one on each side of the lower lobe of the pectoral fin. Is this peculiar to the species or variety*? As connected with the Rays, the fossil body well-known as the graptolite (Prionitus, of Hisinger), is perhaps the most singular and remarkable, and which is supposed by Prof. Ansted to belong to the Testaceæ, at least that is the prevalent opinion: or to be a Pennatula, so common here, or some other zophyte, according to Dr. Beck of Copenhagen, quoted by Mr. Lyall, so that it

* The peculiarity in question is certainly of specific value, we should therefore suppose it to be sufficient to distinguish a species.

remains to this day a knotty question, and it has been recently suggested by an American naturalist, that it may have had a vegetable origin, while I will venture to cut the gordian knot and consider it to be nothing more nor less than the serrated spine of the Raja pastinaca, or an allied species, at least the figure in Lyell's El. Geol. of the Graptolithus *foliaceous* bears a striking similitude to one; indeed the resemblance is so strong, that it is impossible to fail observing the connection or relationship subsisting between them, though I am aware my own view is opposed to the fact established by Dr. Buckland in the Bridgewater Treatise, that no fossil Rays have been detected in any stratum below Lias, consequently excluding them altogether from the *Mudstones* of the Silurian formation, where they are otherwise most expected as being their natural habitat whilst living.

But in doing so I believe I only add an ichthyodorulite of the tail of a Ray, to those of the numerous cartilaginous sauroid fishes of the older rocks. Mr. Orlebar is unable to afford me any light on this subject, and I shall be glad to obtain a well preserved specimen,* however small, of this fossil for microscopic examination of its internal structure for the sake of comparison with that of the spine so abundantly found on the beach of our coast. Well may the Prionitus be classed, as it actually is at present, among *genera incerta sedis*.

I find the discussion going on in the newspapers relative to Mr. Orlebar's antediluvian ocean extremely inviting, as the existence of such a sea (but at a period long anterior to Mosaic creation) may be deduced from well-known data and explained on other theories, particularly on an hypothesis which I have had for years now under review, or been endeavouring to model, as best calculated to illustrate on more general principles, a good many of our geological facts.

We have a few curious shells here possibly undescribed, and of which I shall shortly send you lithographed figures, together with some observations respecting the formation of the Diamond, much at variance as they may be with received opinions.

* Mr. Ansted has been applied to for one.

NOTE.—They are numerous amongst the fossils of the raised beaches on the face of the Khasyah mountains, where they certainly do not, so far as I can remember them, present any relation to spines or crustaceous animals, such at least as we are now acquainted with, although their resemblance to Pennatula is sufficiently striking.—ED.

Extract of a letter from W. Jameson, *Esq., Superintendent Botanic Gardens, N. W. Provinces.*

I returned lately from a tour in Chinese Tartary, having crossed the snowy range of the Himalayas viâ the Neetee Pass. I found the limestone (dolomitic), of which the Pass is formed, filled with organic remains; and probably this is the greatest height (16,800 ft.) where fossil organic remains are met with. I have not yet determined the age of these limestone beds, wishing before doing so to compare the fossils. On the Thibet side of the Pass, I found fossils in vast abundance; and in the bed of the Jhoundoo river, which drains the northern side of the Himalayas into the Sutledge, I found beds of limestone entirely composed of fossils. This limestone alternates with slate clay, which abounds in the nodules and layers of clay ironstone. Our route was along the bed of the Jhoundoo, over numerous streams which we had to cross several times. The bed of the river is in breadth about half a mile. The aspect of the hills is quite different from that of the southern side, being much rounder and softer; moreover, there is not a tree to be seen, the largest bush being a poor Caragana Gerardiana, not more than two or three feet in height. After proceeding along the bed of the Jhoundoo, we ascended a small range of mountains, about 1,000 feet in height, and on reaching its summit had a most magnificent view of the table land of Tartary, a scene far surpassing any thing I had ever witnessed in the Himalayas or Affghanistan. In front of us there was a magnificent flat (though in some places slightly undulated) plain, about twenty miles broad by thirty in length, with here and there small mountains rising out of it, surrounded on all sides by snow-clad mountains. In the north-east was the great Kilas range, whose summits surpassed the highest of the Himalayas that were within vision, and the great Kilas (a conical-shaped mountain, which gives name to the range, and at whose base the Manasorawne lake lies, and issuing from it the Sutledge) towers into the heavens and stands as it were alone as a giant amongst his genii: coursing along the southern side of the Kilas range and through the table land of Tartary, the Sutledge is met with, and which was distant about 15 miles from our camp. The Kilas range separates the Sutledge from the Indus, intersecting the table land in

numerous places and in the generally north course, deep ravines occur, which drain off all the melted snow water. The plain itself was generally clear of snow, with the exception of here and there a few patches—tamarisk and some grapes were almost the only plants to be met with. The animals consisted of the horse, Equus hemionus, it is termed Keang by the Bhoteas, or Ban Ghora: an antilope, An. Hodgsonii: the wild bull or yak, which is said to occur in herds of hundreds. The horse too is common, frequently mares in herds of twenty or thirty being seen, the stallions, however, are always seen singly. The antilope also occurs in vast herds. Two species of sheep, the Burhal, (Ovis nahor) which is common to both sides, being met with in flocks of twenty and thirty from Mulari on the British or northern side of the Himalayas up to the Pass, and on the Thibet side it is equally common. The Nuging, a large and heavier animal, its horns alone weigh upwards of a maund. This species is only met with on the Thibet side. It is nearly allied to Ovis montana of the rocky mountains of North America, and the Argali (Ovis ammon) of Siberia. In fact, from what I remember of specimens sent to the Edinburgh museum from Hudson's Bay, I consider the Indian species identical. I have, however, sent a specimen to Edinburgh for comparison.

A species of hare (Lepus). It is larger than the Alpine hare of England, and is therefore probably the largest species known. It is confined to the Thibet plains and hills.

Marmot, it is termed Phia by the Tartars, occurs in vast numbers on the banks of small streams. It is of reddish-yellow colour, and as large as a rabbit: when alarmed it rushes to its hole and squats itself on its hind legs, and ready at a moment to dip into its retreat. We sent a ball through many, but owing to the above circumstance did not procure them. In fact the only way to be sure of getting a specimen is by sending a ball through the head. My friend Ramsay procured me two in this manner. There is another species met with in the same localities, about the size of a rat, and of a greyish colour. Both of these animals are new to science—and the former, though noticed by some travellers, has not been described. A species of wolf, termed by the Bhoteas, Chankoea. It is much larger than that met with in the plains of Hindoostan, and is nearly allied to

the wolf of Arctic America, figured by Richardson. The leopard; it in size is about that of the common one of the Himalayas, but is of a pale colour, and not so much spotted. Bears are unknown: the Ursus isabellinus, or Burji Bhallow of the Bhoteas, being confined to the snowy regions on the British side. This is very extraordinary, seeing that it is common in Cashmere and in the neighbourhood of Iskardr. At Thana above Budunath, and at Neetee, it is unknown, whilst in the neighbourhood of Mulari, some fifty miles eastward, it is common.

The musk deer (Moschus moschiferus,) occurs as high up as Neetee, but does not cross the Pass—it in its range being confined to the British or southern side of the Himalayas. It occurs from 8,000 feet up to 13,000. Thus it is met at Trongnath and above Neetee. In the latter locality it is rare. Of goats—the Thar (Capra Jemlaica) is also confined to the southern side of the Himalayas, and has a range from 8,000 to 11,000 feet. As soon as we come upon the habitat of the wild sheep (Ovis nahor,) the goat is not found. It therefore is confined to the above range; whereas the Burhal is met with from (11,000) Mulari up to the Neetee Pass, and abundantly as stated on the plains of Tartary. The Himalayan goat presents a very extraordinary character not seen in other goats—viz., in having four teats. The ibex, another species of goat found in Kunwar, is not met with any where, either on the Thibet side or on the British side of the Himalayas, between Thana and Mulari, and seems to be entirely confined to the westward.

With reference to local names, how absurd it is to apply them to animals and plants. Thus from the name one would infer, that the black bear, or Bhallow, is confined to Thibet, seeing that it is styled Ursus Thibetanus,—now it is not found in Thibet at all, being confined to the southern side of the Himalayas. It occurs, however, every where from the base of the mountains to the snows, that is, from Rajpore in the Deyrah Dhoon and in the Dhoon itself, to Neetee, or from a height of 1,000 to 14,000 feet. In October, all the inhabitants of Neetee, Bumpa, Mulari, &c. migrate further down to Josimuth (7,000 feet above the sea) and other towns, and return as the snow melts in March. On their departure the bears take possession of the villages and pull the walls to pieces in search of grain. At Mulari

in particular, they committed great ravages last season. The ruins on our arrival being still standing, presenting more the appearance of an old deserted and tumbling-down town.

With reference to the ornithology of Thibet, every bird that I met with was new to me, and I may say, to science. Here snow buntings (Emberiza), were flying about in flocks. Several species of larks (Alauda); several stonechats (Saxicola), were common. I also saw a pair of Thana hawks (Accipiter); a crow (Corvus), as large as the great Californian one. On one of the lakes at the foot of the Pass there was a duck nearly allied to the Brahminee (Tadorna rutila); a pigeon (Columba), quite a new species, and confined to Tartary. The red-legged crow (Pyrrhocorax), is common to both sides, but on the British or south side is not found under 8,000 feet. But to mention all the novelties would occupy too much space, one only of those I met with below Dumpore I shall notice—viz., a new species of Enicurus. I had already procured the Enicurus maculatus, which however is common, two or three being met with on every mountain stream. The Enicurus scouleri, is, on the other hand, excessively rare, having only twice met with it in the Himalayas, once in Mundi, and lately on a small stream, Goussain ke Oudiar, below Tongnath, and the species now noticed is the first that I have seen. This adds a fourth species to this interesting genus as found in Asia; the genus being first characterized by Vigors from the E. maculatus. Horsfield had described another species under the name of Motacilla speciosa. The Rasores are so regularly distributed in the Himalayas as to present an excellent barometer to mark heights: thus from 1,800 feet to 5,000, we have the Gallus bankiva, and Phasianus pucrasia, &c.: from 5,000 to 8,000 we have the Phasianus Stacii, Tetrao chukor, &c.: from 8,000 to 12,000 Lophophorus refulgens, &c.: and from thence upwards to the snow the Tetraogallus, or snow pheasant of travellers, Columba ———? snow pigeon. With reference to plants this is particularly the case, and for the distribution of one tribe alone, an observer can estimate the height of the regions through which he is travelling—so uniform are the species in their distribution; the family to which I allude is the Coniferæ. But my letter has now extended to too great a length, I must therefore now close, and resume the subject if it interests you.

Hawulbaugh: August 6th, 1846.

Extract of a letter from J. W. Masters, *Esq., respecting his travels and the collections in Assam.*

I have to offer my best thanks for 8 vols. of DeCandolle's Prodromus and 2 vols. Lindley's Orchidea, and you will be glad to hear that these did not reach me till I had arranged all my specimens so far as I was able to do with my slender means, and got to the end of Exogeneæ in a fair copy of the list. Had I received these valuable books earlier, I should, in all probability, have been vain enough to attempt the determination of genera and species, and before I could have got half through my collection, the greater part would have been destroyed. Your kindness, however, I trust will not be entirely thrown away upon me, as I shall be able to take advantage of it whenever I get a fresh specimen.

I yesterday completed the list of my specimens, running the numbers up to 1975, having lost about 100 specimens out of those which I have collected since June 1843, not a vestige of them to be found now, save their numbers and localities in my collection book. Finding that insects and the climate are so destructive, and having no object but the promotion of science, I have determined on sending the bulk of my collections to His Honor the Governor of Bengal, to be disposed of in such manner as may appear most likely to render them of public utility. I therefore have this day written to Major Jenkins on the subject, to whom I have forwarded a copy of the list, and have all the specimens ready for dispatch by the first boat I can procure. As the specimens will probably fall into your hands, some account of the localities from which they were procured may not be altogether uninteresting.

You are aware, that in June 1843, I presented all my Assam and Calcutta collections to Sir William Jackson Hooker through Major Jenkins: whether Sir William has ever made any use of them or not, I have not heard. I did not reserve a single species of my former collection but immediately commenced again, numbering the species in lineal order, heading with the class and order when I could determine them, as—

"No. I. Exog: Monopet: Labiata.
Ovary Super: Scroph:
Torenia Linn.
Stem 4-sided, erect, coloured.
Leaves opposite, alternately one smaller than the other.
Cheriedeo and Hills, June 1843."

This is the method I adopted with my collection book, and with the tickets placed on the specimen on the day of collection; many of these have been destroyed by insects, or lost by the continual change of papers; and though I not unfrequently gave a fresh number to a species already entered, yet I found this method to be of great use to me when I came to arrange into families, and therefore continued it up to No. 1566: after which, I headed with the genus or family only.

From June 1843 to October, I was principally in the neighbourhood of Seebsagur, Nazera Satrorah, Jorehaut, and Deorgaon, and gathered 900 species, but lost many of them during the rains. In November I went to Dopabur, here I found the Limnocharis, No. 1001, seeds of which I sent to poor Griffith, but I never heard if they vegetated. I have never seen the genus in any list of Indian plants. Is it in Wallich's list? From Dopabur I proceeded to Dikho Mookh, and accompanied Major Jenkins up the Brahmapootra to Dibrooghur, Rungagora, Shaikwah, and Suddeya, and returning to Seebsagur in January 1844, I accompanied Capt. Brodie over the Naga hills from the Dikho to the Dyung: the ravines between the hills are very rich, but ours was a hurried march, and I could not stay to explore.

From the hills I returned to Seebsagur, thence I proceeded to Luckimpoor, where I found that curious plant described by Dr. Griffith, Jenkinsia Assamica.* Returning to Seebsagur I again accompanied Capt. Brodie to the hills. After which, in February 1845, I proceeded by the falls of the Nambur through the Rajah Tooleram's country to the falls of the Jumoona. In May and June I arranged, and put in order what I had collected, and in August again proceeded to Luckimpoor, visiting the banks of the Soondree immediately under the Duphla hills: there I found the beautiful gigantic Tacca, No. 1966. From Luckimpoor I again visited Dibrooghur, Shaikwah, and Suddeya, and proceeded as high up the great river as the Brahmakoond. So that all my specimens have been gathered between the falls of the Jumoona and the Brahmakoond.

In the list forwarded to Major Jenkins, I have kept up a running number on the left, and on the right are the corresponding numbers

* Vol. iv. p. 231.

of the collection books, these books you can have if you receive the specimens for the Herbarium at the garden: they contain some rough notes which a botanist might make use of, but they are not fit for the public.

In the first two or three families there is nothing particular, except No. 4—1223, a species of Ranunculus: the structure of this is very curious, exhibiting a circle of 12-cells just within the bark? Of Nutmeg 2 species.

Of Araliacæ, several specimens, of which I have no description. Nandina domestica found at Rungagora. Vitaceæ, several species that require naming. Of Combretum, several, plain to look at, No. 116—1690: when I first saw it on the banks of the Dyung, just under the hills, I thought I had found a new plant, it exhibited such an elegant appearance at a distance; it covered several large trees, and the numerous white bracts made it very conspicuous.

Then comes the beautiful family Melastoma. I have numbered 20 specimens, and have given Roxburgh's names to several of them, but his descriptions are so short that I know not if I am right.

Of Myrtaceæ, about 20, but I am not aware that there is anything new. Jambosa malaccensis I have met with in the forest.

Loranthaeæ and Cucurbitaceæ, which are so common, I can do nothing with, but in a fresh state; in fact the growing plant is required, for a detached specimen very soon becomes unfit for examination. You will probably smile at my having occupied 16 numbers for one species—the tea—but these specimens have been carefully selected for the express purpose of shewing to those who understand the subject, what effect the nick-named cultivation has had upon the plants.

Sterculiacæ and Malvacæ rather numerous. I am very doubtful about many of Roxburgh's names which I have given. The plant I have called Hibiscus Griffithiana is a very powerful climber, and very common on the banks of rivers. I first thought it was H. scandens, Roxb., but having carefully examined it, I do not find that it agrees with his description. The flowers are very fragrant. Elæocarpus and Dipterocarpus require close examination.

The Euphorbiacæ are very common and very puzzling, and require much examination. Of Rosacæ, the genus Rubus is the principal. I have no Roses except from gardens.

Then comes the tremendous family of Leguminosæ, and how are we to determine the old Hedysareæ, when one botanist gives 10 names to one species, and another botanist allows but one name to 10 species. Of this family I have given 130 species, some of the names I know to be correct, but some are doubtful.

Of the Anacardeæ and Cupiliferæ there are some good specimens, but I have not been able to determine the different species of Rhus and Quercus.

One plant which I found on the Naga hills, I have marked as a species of Betula, but it being so much like a plant at the gardens called Balsamodendron Roxburghii, makes me apprehend I may be mistaken.

In Urticeæ there is a variety of nettles and figs, but I am not aware that any of them are new, though I could not recognize them by Roxburgh's descriptions, and I had no other to refer to. When at Seebsagur, I had access to Rees' Clyclopædia, but unless I already knew the genus to which my specimen belonged, that work was of no use to me.

Of Polygoneæ, I have numbered 30, and there may be even more among the Duplicates: one specimen I have called P. fragrans, and have frequently sent seeds to the gardens. On the 5th April 1844, I sent a description of it to Dr. Griffith, for the Journal, but I heard no more of it afterwards, perhaps he did not think it sufficiently correct.

Myrsineæ is almost a dead letter to me. I am more at home in Cinchoneæ, and you will find some fine specimens of Mussænda. One I have called M. scandens, is a very powerful climber, and the white calycine leaves make it very conspicuous when running over the tops of high trees; it is not in Roxb. nor in W. and A. Another Mussænda, or an allied genus, is a most elegant shrub which I found growing out of a perpendicular clift up the Soondree. Of Compositæ, you will find 70 or 80, the most interesting are Nos. 1028—1382 and in my plants of the Naga hills, As. Jour. No. 479. By the bye I have no copy of that paper, and I suppose it is too late now to procure one.

Verbenacæ affords a variety of Callicarpa and Clerodendron.

I had several Cyrtandracæ, but I fear they will be of no use, having all fallen to pieces, and when I found them I had no time to make

notes, and had no description to refer to. So far; but I will not weary you any more, if you require any more information than is found in the list, I shall be happy to afford it if possible. In justice to myself, I ought to tell you, that all my collections have been made entirely at my own expence.

Golahghat, 1st October, 1846.

Further Discoveries of Coal on the Northern side of Assam.

Extract of a letter from Major Jenkins, *dated 17th October,* 1846.

The discovery of the vein of coal by Dalton is likely to lead to more discoveries, in the same quarter, of this precious mineral: however, I can hardly call ours precious as yet, as we are not able to turn it to any account, but these great deposits will surely be of local use by and bye.

Vetch writes to me under date the 7th instant—

"I have just got in some most beautiful specimens of coal from a stream on the north bank, where I put some people to look out for it; this stream is a day's journey above that in which Dalton discovered coal. I have also got information of its being in the Seesee river, but I cannot go just now."

These two streams will be east and west of Dalton's locality, so that it is all but certain there are as large deposits on the north as the south bank.

Extract of a letter from Capt. Vetch, *Political Agent, to Major* Jenkins, *Commissioner. Debroo Ghur, 22nd October,* 1846.

I have returned from my trip to Sudeya, Suckwah, and the country along the Booree Sootee, and have now the pleasure to send you some specimens of coal obtained from a low hill adjoining the plains, within a very short distance of the banks of the Dakaroo, a pretty hill stream, which flows from the Abor country into the Booree Sootee.

The coal appears to be remarkably fine and singularly heavy, but I am sorry to say the stratum is so thin, as to be of no further use than to indicate that a thicker may be near. The stratum is well raised above the bed of the river, and can be approached to within a short distance by canoes during the rains, while the direct distance between it and the Booree Sootee cannot be above six or seven miles.

I had not an opportunity of examining any specimen of the coal Dalton found in the Durgmoo, which also flows from the same range of hills considerably more to the west, but this may possibly be a continuation of the same strata, and if I am rightly informed, coal is also to be found in the Seesee river, (or its tributaries) which is still more to the west: this would indicate that there is coal running all through this lower range of Abor hills. All these streams, the Seesee, Decmoo, Durgmoo, Dakaroo, as also the Dapii to the east of the latter, fall into the Booree Sootee, are noted for the abundance and excellent quality of the gold obtained by washing the gravel found in their respective beds.

I was well pleased with the Booree Sootee, the upper part of which flows through a much more open description of country than is generally to be found in Assam when abandoned for many years, and it may some day again become even more important than it was some fifty years ago, when about 900 gold washers were located along its banks. The rate at which they were taxed being half a tolah of gold per man, for which some remission was made to meet the exactions of the Abors, but as these exactions of the hill people became more and more oppressive, the population decreased, and the whole of the country upwards from Seesee was abandoned by these gold washers, a good many of whom are settled at Debroo Mook, and the rest scattered all over the country.

Extracts from Dr. LINDLEY'S *new work on the Vegetable Kingdom, adverting to the discoveries of the late* WILLIAM GRIFFITH, *Esq.*

PHILESIACEÆ.

217. In the last edition of this work I regarded these plants as forming a part of the Roxburgh-work; but the discovery by Mr. Griffith, that the carpel of these plants is quite simple, and a further consideration of the parietal placentæ, orthotropal ovules, and hexamerous flowers of the Philesiads, has decided me to separate them, in the belief that recuits may be hereafter found for them. Very little is known about them at present; no one has analysed their seeds, and it is even doubtful whether the two genera here brought together are so closely allied as is supposed. For my part I only know the ovules of Philesia. Lapageria looks like a Smilax bearing the flowers of a Bomarea.

ROXBURGHIACEÆ.

219. I, however, formerly regarded it as more nearly allied to Arads than to anything else, and Mr. Griffith has so far agreed with that opinion as to consider it certainly one of the class of which Arads are the type; in which he has apparently been influenced by the discovery of a slit on one side of the embryo. But this character has lost its value ever since the discovery by Adr. de Tussien, that a slit embryo is found very generally in Endogens; and a diclinous spadiceous inflorescence is indispensable to Arads; so that this view of the affinity of Roxburghia can hardly be maintained. It would rather appear to be the type of an order for recuits to which we have still to look. In the meanwhile it may be looked upon as a tendency towards Arals on the part of Dictyogens. Roxburghia is said to have stems 100 fathoms long. Mr. Griffith regards the pistil as consisting, beyond all doubt, of one carpel only, as "is indicated by the obliquity of the ovary."

GNETACEÆ.

232 and 233. Within which is a thinner envelope, through which passes a tubular projection fringed at the point, and within these lies a nucleus, as is represented in the accompanying figure of the young

ovule Gnetum Brunonianum, copied from an unpublished drawing by Mr. Griffith. So that this sort of ovule has three distinct integuments, clear of the nucleus. It is to Mr. Griffith that I owe the knowledge of the true nature of these plants. In a most elaborate unpublished Memoir on the structure of Gnetum, he shows that in reality the whole of the apparatus belongs to the ovulum. In that Memoir (dated August 4th 1835), which unfortunately did not reach me till after the publication of the last edition of this work, there is the following description of the development of the parts of this extraordinary structure:

"At a period long before the exsertion of the anthers, the ovules, which lie upon the male flowers, are generally of an oblong form, and consist of a central cellular solid body, inclosed in two envelopes. The outermost of these is fibro-cellular, and divided longitudinally on the upper face, or that nearest the axis; the fissure extending nearly to the base of the ovule,* the inner or second envelope is cellular, and is divided irregularly towards its apex.

"This envelope does not, at this period, entirely inclose the nucleus: the points of some of the lacineæ or divisions project occasionally beyond the apex of the outer envelope. The nucleus is an oval or oblong cellular body, rounded off at its apex, which is composed of lax cellular tissue.

"The next change consists in the commencement of the obliteration of the longitudinal fissure, existing along the posterior face of each outer envelope, and of an extension of the inner coat over the nucleus, the apex of which becomes more or less depressed: the centre of the depression, however, projecting in the form of a cone of a very slight elevation. At the time of flowering, or of the exsertion and dehiscence of the anthers, the fissure originally existing along the upper face of the outer coat has disappeared; with the exception of a small portion at the apex of the ovule, which remains unclosed throughout. The ovules are at this period in some species oblique. The inner envelope is generally entirely enclosed within the outer; the points of its lacineæ reach, however, to the opening existing in the apex of this latter, and occasionally, but by no means univer-

* "This division is perhaps similar to that which Brown states to take place in Dacrydium."

sally, project beyond it to a short distance. This coat has undergone scarcely any change, and corresponds in shape to the cavity of the outer envelope. The nucleus is completely covered by both integuments and its apex, which continues of the same form, is occasionally tinged with brown. Within its substance, which is entirely cellular, and towards its centre, there exists a small cavity, lined with a membranous sac, attached apparently to the apex of the cavity, and containing a number of minute grumous-looking brown masses arranged without any obvious regularity. This sac, I consider to be the amnios, with which it agrees in its development and subsequent disappearance; it exists at a rather early period, and is developed within a cavity formed by some excavating process.

"A short time after the fall of the male flowers, an extraordinary change will be found to have occurred, consisting of the very rapid and apparently sudden development of a new membrano-cellular envelope between the second coat and the nucleus. This new formation, which I may term the additional coat, envelopes the nucleus pretty closely, and is continued upwards beyond the apex of the nucleus into a cylindrical tubular process; the mouth of the tube being laciniate or fimbriated. At the period now referred to, its apex barely projects beyond the outer envelope. During its development no particular change has taken place either in the original integuments or nucleus. At a somewhat later period, the ovules, except in the instance quoted in the note, hitherto concealed by the involucre, will be found exposed, and the outer coat to have become of a green colour."*

GNETACEÆ.

234. Independently of the singular organization of its ovule, the genus Gnetum is remarkable for some other peculiarities. Its seed, which resembles a drupe, has within their fleshy integument, a layer of needle-like woody tissue, of a very remarkable nature, freely separating when disturbed, and looking much like the hairs of Cowhage. The embryo, according to Mr. Griffith, is attached to an "enormously long tortuous and spirally but irregularly twisted

* "In one species G. Brunonianum the ovules are at an early period exposed, owing to the obsoleteness of the annulate involucre."

cellular funiculus, the cells of which are much elongated and twisted. Its length varies, when moderately pulled out, from three and a half to five inches; the whole length of the seed being about an inch. This funicle, as well as the extremely similar one of Cycas, has the property of contracting when immersed in water."

LARDIZABALACEÆ.

303. Stauntonia has the placentation of Flacourtia, according to Griffith.

PODOSTEMACEÆ.

482 and 483. Bongard first represented their true structure, and more recently Mr. Griffith has described two Indian species of Podostemon, with his habitual accuracy; entirely confirming the view which I, upon mere theoritical reasoning, formerly took of their being Exogens. And I am still of opinion, that if we have among Exogens one type of structure more nearly approaching that of Acrogens than another, it is this, which, with the habit of Liverworts and Scale-mosses, has wholly the structure of flowering plants. According to Bongard, the species have neither spiral vessels nor stomates; the latter would of course be absent, on account of the submerged habits of the species of Mourera to which his observations chiefly apply. And Mr. Griffith confirms his statements as regards his two Indian Podostemons.

CUSCUTACEÆ.

634. These parasites are found in the temperate parts of both hemispheres, twining round the branches of plants, sometimes producing great destruction among crops. They do not appear to occur much in the tropics, where their place is perhaps taken by Cassyths. Mr. Griffith speaks of a gigantic species in Affghanistan, which even preys upon itself; one of its masses half-covered a willow tree, twenty or thirty feet high.

RHIZOPHORACEÆ.

726. DeCandolle points out its relation to Vochyads and Myrobalans, and even to Melastomads, through the genus Olisbea. The genera were comprehended in Loranths by Jussieu. Mr. Griffith

has explained with his usual skill the nature of the anther in Rhizophora. In the plants belonging to that genus the anther is alveolar, the sockets being filled with pollen, and in this circumstance it resembles Viscum; but in its younger state the anther is oblong, compressed laterally, and uninterrupted on its surface; when it is mature its two faces fall away, and leave behind a solid centre, in cavities of which the palm has been generated. See Transactions of the Medical and Physical Society, Calcutta.

APIACEÆ.

776. Of these Ferula asafœtida is the plant described by Kœmpfer (Amæn. Exot. 533,) but F. persica and others are no doubt also the origin of the drug. Griffith was of that opinion, (Ann. N. Hist. X, 193) and the fruits sent home to me by Sir John McNeill prove the fact.

HAMAMELIDACEÆ.

784. Mr. Griffith observed in Bucklandia and Sedgwickia that the woody tissue is marked with circular dots, something like those of conifers; the same sharp-sighted botanist observed that in Bucklandia the second membrane of the ovule protrudes beyond the foramen in the ripe seed!

ACROGENS.

51. Sexes, however, are wholly missing; that is to say, nothing can be found which resembles the anthers and pistil of flowering plants, except in some vague external circumstances: there is no evidence to show that any one order of Acrogens possesses organs which require to be fertilized, the one by the other, in order to effect the generation of seeds. Hence those reproductive bodies of Acrogens which are analogous to seeds are called spores. Mr. Griffith takes, however, a very different view of this question, and assigns true sexes to Acrogens.

He thinks it probable that we have at least three modifications of the phenomenon of fecundation "among the higher acotyledonous plants. In one the male influence is applied to the apex of a pistillum, in the second to a nucleus without the intervention of pistillary apparatus. In the third the male influence is exserted on a

frond itself, and is followed by the development of the young capsule from a point in the substance of the frond, corresponding to and sometimes distant from the place to which the male influence has been applied. This is founded on observations made on Anthoceros in 1836, from which it would appear that the place of exsertion of the future capsules is pointed out by a slight protuberance, over the apex of which, a flake of matter, like the so called male matter of Musci and Salvinia is spread, sending down to some distance within the frond a tube-like process, which causes the dislocation of the cells of the tissue with which it comes into contact. The future capsule is stated in his notes not to be appreciably pre-existent, and its situation is only pointed out by a bulbiform condensation of the tissue of the frond. The young capsule during its development ascends along the same line, and pushes before it a corresponding cylindrical body of the tissue of the frond, the calyptra of authors." But it seems to me, that this very complexity of action is more like variations in self-propagation than phenomena of fecundation, which, among the plants in which that action takes place, is subject to no such modifications.

MUSCALES.

55. Upon this point, however, Mr. Griffith, observes, that "it is to be borne in mind, that whereas pollen is the result of a simple separation constituting a primary and independent process in Musci, Hepaticæ, Salvinidæ, the spores, otherwise so similar to pollen, are the result of a secondary process dependent on a primary one, which appears to be remarkably analogous to phanerogamic fecundation."

Finally, Unger, in his account of the anatomy of Riccia (*Linnæa* xiii. 13), states that antheridia and pistillidia are alike at first, that the contents of the first are lost, of the second retained, and that the first perishes while the second is permanent, whence it is reasonable to presume that the emission from the antheridia is a necessary condition for the formation of spores. He therefore regards them as male and female.

It seems clear from all these statements, that the question of sexes in the Muscal alliance is undecided. There is no doubt that two

very different sorts exist among its species; but it does not appear to me that we have sufficient evidence at present to show that the antheridia are male organs. So far as they are concerned we have conjectured and nothing more. All that is proved is:—i. That the spores are bodies which reproduce the plant, and are therefore analogous to seeds:—and ii. That the structure of the antheridia and pistillidia is wholly at variance with that of anthers and pistils properly so called.

Mr. Griffith, nevertheless, in an elaborate Memoir on Azolla and Salvinia, published in the Calcutta Journal of Natural History, adopts in the fullest extent the opinion that Acrogens have sexes, as will appear hereafter. It is, however, to be remarked that the question is not whether there may not be in such plants as these some trace of a male and female principle, or certain organs in which it is probable that such a principle resides; but whether there is any such structure as that which we know to be sexual in all classes of plants higher than Acrogens. And I must confess after reading Mr. Griffith's very learned and ingenious observations, that my opinion remains unshaken as to the existence of most essential differences between Acrogens and other plants in all that regards the organs of reproduction.

EQUISETACEÆ.

61. In fact, they appear quite anologous, as Mr. Griffith has stated, to the elaters of Marchantia and its allies, to which the order bears perhaps a nearer relation than to any other plant.

BRYACEÆ.

65. Mr. Griffith (Calcutta Journal, Vol. V.) strenuously advocates the sexuality of the antheridia and pistillidia, regarding the former as a true male apparatus, and the latter as a pistil containing an ovule. I do not know that he has anywhere adduced proof of the validity of this opinion; and it is difficult to comprehend upon what evidence that theory depends; it may, however, be presumed, that he considers the spores to be analogous to embryos formed in vast numbers. This admirable observer thinks, that evidence in favour of fecundation in some way in Mosses and Liverworts is afforded by the break-

ing up of the tissue, terminating and closing what he calls the style, that is to say, the point of the pistillidium, subsequently to the application of a particular matter, whereby the style becomes a canal, opening externally by a browning observable in the orifice of this canal extending downwards until it reaches the cavity of the (his) ovary, and by a corresponding enlargement of a cell (his ovule) existing in that cavity. Mr. Valentine, however, does not regard these appearances as connected with fecundation.

MARSILEACEÆ.

72. Following Jussien, Salvinia and Azolla were separated in the last edition of this work as a distinct natural order, a view that Endlicher has since taken. But upon a full consideration of the structure of these plants, or of what is known of it, it does not appear to justify the separation. Like Pilularia and Marsilea, they have two distinct kinds of reproductive bodies enclosed in involucres, and that seems to be the main feature by which Pepperworts are known as an order from Lycopodiaceæ. For the same reason it appears better to combine with them Isoetes, instead of regarding that too as the type of still another order. Mr. Griffith does not include Isoetes among these plants; but I cannot assent to the propriety of erecting every genus in this curious order into a suborder.

The genera Salvinia and Azolla have been the subject of some elaborate observations by Mr. Griffith, (Calcutta Journal, Vol. V.), who elevates each into a suborder, and throws an entirely new light upon their structure. He regards them as having true sexes, the male being certain necklace-shaped threads found, at an early stage, in contact with what he denominates an orthotropous ovulum. But strange to say, this so called ovulum, instead of giving birth to an embryo, becomes the parent of reproductive bodies of two totally different kinds, having not even the smallest resemblance the one to the other, although the matrix out of which they are evolved is identical at an early period of the organization. I regret that Mr. Griffith's most curious memoir only reached me as this sheet was going to press, so that it was impossible to have cuts prepared to illustrate his observations, for which the reader is referred to the

work above quoted. All I can do is to give in a note the substance of his descriptions of Salvinia and Azolla.*

* "*Salvinia verticillata.*—Male organ ? articulated hairs on the stalks of the ovula ; each joint containing a nucleus and a brownish fluid ; ovula nearly sessile, concealed by the roots, and partly covered with hairs ; tegument open at the top ; mature reproductive organs solitary, or in racemes of 3-5, about the size of a pea, covered with brown rigid hairs, the upper ones of each raceme (or lowest as regards general situation) contain innumerable spherical bodies of a brownish colour, and reticulated cellular surface, terminating capillary simple filaments. These again contain a solid whitish opaque body. The other which occupies the lowest part of the raceme, and which is the first and often the only one developed, is more oblong, containing 6-18 larger, oblong-ovate bodies, on short stout compound stalks : colour brown, surface also reticulated. Each contains a large embossed, opaque, ovate, fin body, of a chalky aspect ; it is 3-lobed at the apex, and contains below this a cavity lined by a yellowish membrane, filled with granular and viscid matter and oily globules.

"*Azolla pinnata.*—The growing points present a number of minute confervoid filaments, the assumed male organs, which at certain periods may be seen passing into the foramen, the ovula becoming resolved into their component cells within the cavity of that body ; organs of reproduction in pairs attached to the stem and branches, one above the other, concealed in a membranous involucrum ; ovula atropous, oblong-ovate, with a conspicuous foramen and nucleus, around the base of which are cellular protuberances ; capsules of each pair either difform, in which case the lowest one is oblong-ovate, the upper globose, or both of either kind, generally perhaps the globose, presenting at the apex the brown remains of the foramen, and still enclosed in the involucrum ; upper half generally tinged with red ; the oblong-ovate capsule opens by circumcision ; with the apex separate, the contents which consist of a large yellow sac contained in a fine membrane, the remains of the nucleus (or the secondary capsule). The sac is filled with oleaginous granular fluid, and surmounted by a mass of fibrous tissue, by which it adheres slightly to the calyptra ; on the surface of the fibrous tissue are 9-cellular lobes (the three upper the largest), which when pulled away, separate with some of the fibrous tissue, and so appear provided with radicles. The globose capsule has a rugose surface from the pressure of the secondary capsules within ; these are many in number, spherical, attached by long capilliform pedicels to a central much branched receptacle ; each contains two or three cellular masses, presenting on their contiguous faces two or three radiciform prolongations. In their substance may be seen imbedded numerous yellow grains, the spores."

RHIZOGENS.

87. More recently, Mr. Griffith has adopted the views of Brown, and endeavoured by new arguments, to show that Rhizogens cannot be regarded as a peculiar class in the vegetable kingdom. He is of opinion, that "in the construction of the group, a remarkable diversity of characters has been sacrificed to an appearance resulting from parasitism on roots, and to an assumed absence of an ordinary form of vegetable embryo." He asserts, that these plants are not similar in their parasitism, and that in those which he has examined there would appear to be two remarkably different types of development of the embryo. He thinks, moreover, that such a class is opposed to the system of nature, a chief point of the plan of which consists in an extensive interchange of characters, either positively by structure, or negatively by imitation of structure. The want of uniformity in opinion of the founders of the group regarding its rank or value, is incompatible with any group of the system of nature. And he is persuaded that Rhizogens are an entirely artificial class, not even sanctioned by practical facility, which is the only merit of an artificial association, and a retrograde step in the course of philosophical botany. This being the case, it was of course necessary to show where the genera of Rhizogens can be stationed, if they are not collected into one common class, as is here proposed. Accordingly, Mr. Griffith suggests, that the genus Mystropetalon may be "the homogeneous-embryo-form of that order which he takes to include Proteaceæ, Santalaceæ, &c. and which nearly agrees with Professor Lindley's alliance Tubiferæ." The tendency of Sarcophyte is, he thinks, towards Urticaceæ, and he also considers Balanophora as the homogeneous-embryo-form of Urticaceæ, forming a direct passage in one, and usually the more perfect structure of Musci and Hepaticæ. "Finally, he stations his genus Thismia between Taccaceæ and Burmanniaceæ." (Proceedings of the Linnæan Society, No. xxii. p. 220.)

APOSTASIACEÆ.

184. Perennial herbaceous plants; stem simple or branched. Leaves firm, thin, sheathing at the base. Flowers in simple or compound terminal racemes. Calyx and corolla each consisting of three similar pieces. Anthers two or three, sessile upon a short column, erect 2-celled, opening longitudinally; pollen cohering in 3s. or 4s. according to Mr. Bauer, in single oval grains with a longitudinal furrow

according to Mr. Griffith (letter dated Mergue December 28th, 1834) and Blume. Ovary 3-celled, with three polyspermous placentæ in the axis; ovules with their integuments very distinct and much shorter than the protruded nucleus (Griffith.)

Selections.

Copper in the Bile.

It appears from the experiments of Bestozzi that he has discovered distinct traces of copper in dark-coloured human gall-stones, though he has failed to find them in the bile. The quantity of copper seems to bear a distinct proportion to the darkness of the colour of the gall-stone. These results have been confirmed by Heller, who discovered copper by another and simpler method; also by a Dr. Gowp—Besauer, who has discovered copper not only in dark coloured gall-stones, but also in the human and in ox-bile. It will be curious to see whether these results are confirmed by further researches.

General review of the causes of death in the Prussian army, in the year 1844.

Nervous fever,	152
Abdominal typhus,	248
Inflammatory fever,	127
Consumption,	317
Dropsy,	52
Old age and debility,	41
Delirium tremens,	26
Apoplexy,	23
Lungs and dysentery,	9
Scarlet fever,	8
Small-pox,	3
Epilepsy,	2
Hæmatemesis,	2
Cancer of stomach,	2
Medullary sarcoma,	2
Traumatic tetanus,	1
Disease of heart,	1
Hæmoptysis,	1
Depression of spirits,	44
Suicide,	38
Total,	1,099

Results of Re-Vaccination in the Prussian army in 1844.

Of	40,661	men who were re-vaccinated,	
	32,779	had plain scars on their arms,	
	5,463	,, indistinct ones,	
	2,419	,, none at all.	
Of the	40,661	re-vaccinated, the vaccination	
		ran in its course regularly in	21,038
		irregularly in	79,445
		failed in	11,671
			40,661

The vaccination was repeated among the 11,678, with success in 2,278 cases, thus leaving only 9,400 out of the 40,661 in whom it was unsuccessful.

Of the men re-vaccinated successfully, 5 got varicella, 8 varioloids, 1 small-pox, within the year.—*Rust's Magazine.*

Dr. Sangbusch, *on Fish Poison.*

The morbid phænomena consequent on eating unwholsome fish, whether fresh, or salted, and in the earlier stages of poisonous putrefaction, are, more or less lasting disturbance of the digestive apparatus, and are in both cases, even where the poisoning is violent, unmistakeably alike. Yet symptoms referable to other organs occur according to the varying causes that may have led to the putrefaction, and according to the difference in the species of the fish. Dr. Sangbusch first describes the symptoms resulting from the consumption of raw, salted, or putrid fish, belonging to the sturgeon family. They are, oppression and feeling of tightness, with violent burning, pain in the præcordia and stomach, a few hours after the fish has been eaten: feeling of corrugation and dryness in the mouth, violent thirst, transitory heats, nausea, and vomiting: sharp cutting pain in the abdomen, (which is at times spasmodically tense, and feels hard, at others is drawn up, but feels soft, and is painless,) obstinate constipation or alternating diarrhœa: strangury often amounting to complete retention: difficulty of swallowing, in some cases even total inability to swallow fluids: difficulty of respiration,

headache, or violent swimming in the head: dilatation of the pupils, immobility of the iris, blueness of the face: small, weak pulse: numbness of the points of the fingers, coldness of the extremities, marked sinking of the vital powers. If these symptoms go on increasing to a certain point, death results from paralysis of the nervous system and suffocation, consciousness remaining complete. The author never observed convulsions. In cases of recovery, the collapse and the characteristic symptoms suddenly cease. But giddiness, imperfect vision, dilatation of the pupils, weakness and hoarseness of the voice, and lassitude remain longer. Occasionally there is an increase of all the symptoms, just before they begin to remit: sometimes also before complete recovery, swelling of the parotids, with tendency to abscess, takes place, as does at times erysipelatous swelling of the face. The author has never observed any disturbance of the mental powers as one of the sequelæ.

The symptoms thus detailed are dependent on a temporary excitement of the blood vessels, which is, however, scarcely recognisable in some cases, because as soon as the poison reaches the blood, it is followed by a violent affection of the ganglionic system, and especially of the *great sympathetic* and *vagus* nerves, while the brain and spinal column sympathize. On reviewing the foregoing account of the action of fish poison, we see that it corresponds very much with that of poisonous sausages, with the exception of the paralysis of the upper eyelid characterstic of the latter, which Dr. Sangbusch never observed: on *post mortem examination,* there were observed signs of inflammation and gangrene in the stomach and intestines, and traces of previous inflammatory excitement in the mucous membrane of the respiratory organs, heart and lungs; liver and spleen, soft; the blood fluid; no organic alteration of the nervous system.

The effects of the poison developed under certain conditions by living fish, vary according to its intensity and the constitution of the party affected by it. In the slighter cases, the illness is confined to oppression about the stomach, vomiting, diarrhœa, lassitude, thirst, constriction of the forehead; in severer cases the symptoms vary according to the order of the fish from which the poison was derived.

Thus the attacks caused by eating the Pike, Barbel or the *Silurus militans*, the *Muræna conger*, and the *Bodianus guttatus* and *Casta-*

neus, depend chiefly on the sympathy of the ganglionic system, which by reflex action on the circulatory system causes increased secretion of the inner surface of the alimentary canal. Brain and spinal column suffer only by sympathy, and in a less degree. In fact the symptoms exactly correspond with those described by Dr. Autenrieth in his work on this subject, as the *choleric.* Paralysis of the nerves, of sense, and motion ends the scene in a few days. In cases of recovery, the convalescence is tedious. Still more serious are the nervous symptoms that follow poisoning by the *Muræna ophis,* the *Ostracion Glabellum,* the *Tetrodon ocellatus,* and *Sceleratus:* in fact this form of poisoning, which is characterised by great lassitude, giddiness, nausea, loss of feeling in the extremities, fainting, convulsions, and wandering of the mind, may be regarded as the *paralytic,* although some disturbance of the alimentary canal is also manifested by vomiting of blood or of a viscous matter: after poisoning by the *Gadus ægelfinus,* the *Otaheite Eel,* the *Perca venenosa,* the *Coryphæna cærulea,* the *Scomber regalis* (boneto,) the *Esox bocuna* and *Scomber alalonga,* the attacks are of the sort described by Autenrieth as *scarlatinous* or *exanthemetous.* The most deadly poisoning of this kind is that caused by the *Esox Baracuda,* the *Spanus pagrus,* and the *Clupea thripa.* Its symptoms are the following: an exanthema of wheals, intolerable itching and burning of the skin, distracting headache, violent swimming of the head, and blueness of the countenance, followed by spasm of the throat and burning, fearful cramps in the legs and bowels, tenesmus and strangury, intense flow of saliva, swelling of the joints, violent pain in the periosteum of the tibia. Death ensues either accompanied by violent cramps when the œsophagus and stomach are found violently inflamed, or seems to result from extreme prostration of strength, the latter sometimes caused by suppuration under the skin. If the illness takes a favourable turn, the epidermis desquamates, nails and hair fall off, and matter forms in the palms of the hands and in the soles of the feet. Convalescence is very tedious, and for a long time pains and cramps in the limbs, or lameness of them, a burning feeling in the soles of the feet, and general weakness continue. The paralytic form of poisoning is characterised throughout by symptoms of great depression and suffering of the nervous system, accompanied with signs of the blood being diseased. It is observed after eating fresh

as well as salt or half putrid fish. Death in these cases seems easy and painless, without signs of any previous excitement, and occurs along with sudden sinking of all the powers, slight wandering of the head, or feeling of intoxication, with which ringing in the ears, numbness of the limbs, difficulty of swallowing, Epistaxis and at times petechial eruptions are associated. The intensity of the operation of the fish poison naturally depends much on the susceptibility of the patient at the time when he is attacked, and is of course greater in some cases than in others; in a few instances people escape entirely, but those who have once suffered from such an attack, suffer a second time very much less. Animals also suffer from this poison: thus flies, fowls, ants, cats, dogs and pigs are killed by the poison of some fish. The resemblance between fish poison and that of muscels is very striking.

As to the circumstances under which this poison is developed in salted fish, the author refers to the following:—1. Imperfect salting—2. Delaying to salt it while the fish is quite fresh—3. Salting it after the signs of putrefaction have already set in—4. Want of care in preserving the salted fish against the changes of a Russian climate. It is remarkable that no fresh fish which has been boiled has ever proved poisonous, which would seem to indicate that boiling destroys the poison. As to the causes of fresh fish becoming poisonous, the author thinks, the chief to be their being kept in foul tanks to be ready for market, and their being eaten at the time when they are spawning, when their flesh is less firm. None of the foregoing remarks allude to actual putridity, in which state the Greenlanders eat their flesh, and the Chinese make soup of stinking fish.

As to treatment, of course the first indication is to get rid of the poisonous substance by emetics, followed by purgatives; the second to neutralise the poison already absorbed, for which purpose West Indian doctors give strong solutions of table salt or the juice of the sugar-cane in its first stage of fermentation. Strong coffee, alcalis and liver of sulphur have been strongly recommended in poisoning from sausages; of course when the greatest danger is over the extreme depression is to be counteracted by stimulants, &c.—*Abridged from the Russian Medical Times and Allgemeines Repertorium.*

Geological Report on a portion of the Beloochistan Hills. *By Capt.* N. Vickary.

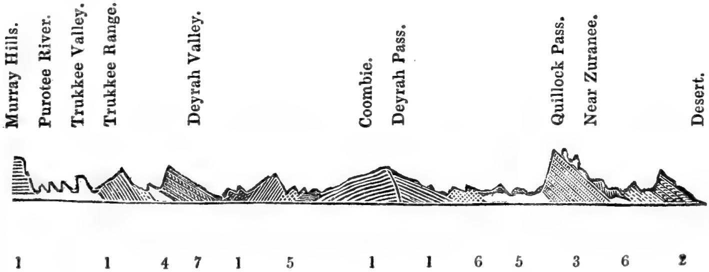
[Communicated by Sir R. I. Murchison, G.C.S., F.G.S.]

The hill country visited extends from Shahpoor on the western side to Goojeroo on the east, a distance of about ninety miles, and from the sandstone range, bordering the Desert, to the Murray Hills, in a northerly direction about fifty miles. The strike, and the direction of the ranges and of the valleys is nearly east and west, and the mean dip of the beds southerly.

There are seven parallel ranges of mountains gradually increasing in height from the low sandstone range bordering the Desert to the Murray Hills, the most northern point visited. The low sandstone range bordering the Desert was scarcely touched upon, but from its appearance I conclude that it does not differ in structure from the second sandstone range; it dies away towards the west, but appeared to extend in an easterly direction as far as the eye could reach.

The second sandstone range in which the Jullock, Gundava, and other passes are situated, extends also to an unknown distance in an easterly direction, but towards the west, near Shahpoor, it approaches and eventually abuts upon the first limestone range.

North. Section from Murray Hills to The Desert. South.



No 7. Conglomerate of Deyrah Valley.
6. Sandstones and clays.
5. Bone gravel.
4. Conglomerate.

No. 3. Sandstone of second range.
2. Sandstone of first range.
1. Nummulitic limestone.

I annex a section running nearly north and south, that is, at right angles to the direction of the mountain ranges, and along the pitch of the strata. It is drawn up from memory, and though not exactly correct, is sufficiently near the truth.

Between the place called Ooch and Shahpoor low sandstone hills make their appearance, belonging to the outer range. The dip of the strata is different on different hills, but the mean inclination is south (that is towards the Desert), at about 12°. A diluvial gravel is spread over the whole, the boulders varying from the size of a man's head to the smallest pebble; these boulders are present on the highest parts of the sandstone ranges, and are derived from the nummulitic limestone to the northward; they contain the same fossils, and have the same mineral structure. Ooch is a remarkable place, and deserves a special notice: it is a point upon which I should be disposed to think volcanic force may have formerly acted. It is a valley about half a mile in breadth and two and a half miles in length, and its direction is curved, at first tending towards the east, but soon turning north-east and NNE. The sandstone dips *from* the valley on each side at an angle of about 15°, presenting an abrupt face inwards of about 200 feet in height. The surface of the rock is strewed with nummulitic limestone, which consists of gravel with a few small quartz pebbles intermixed, and the sandstone is partially capped with a more recent gravelly sandstone of from two to four feet in thickness, containing numerous nummulites and a few rolled mollusca. Beneath the sandstone there is an aluminous clay, and the whole is penetrated with veins of foliated gypsum, some of which are of considerable thickness, but neither the sandstone nor aluminous clay afford fossils. The central portion of the valley is highly saline, as are most of the springs; the saline matter (chiefly soda?) effloresces, and could be collected in any quantity. I was told that a tepid spring existed in the centre of the valley, but I was unable to discover it.

From Ooch to Jullock Pass, in an easterly direction forty miles, there is a little change in the geological aspect of the country,—the same sandstone beneath, and the surface covered with the same diluvial gravel. The only difference to be noted in the Jullock Pass (the second sandstone range) is, that the sandstone is thrown up to a greater elevation. It is identical with the Ooch sandstone, and is capped with similar nummulitic boulders, while the base is the same fine-grained sandstone as that just mentioned, without fossils.* The

* I had no instrument for ascertaining heights.

elevation of the highest points above the pass is not more than 400 feet, but these elevations form a well-marked range parallel to the limestone ranges on the north, and also parallel to the lower sandstone range flanking the Desert. The direction of the range is nearly east and west, and the dip tolerably regular to about 15° south, or a little to the east of south. There are numerous passes through this range; they are clefts formed at the time the sandstone was upheaved, and the drainage of the mountains to the north is effected through them.

About six miles from the Jullock Pass, in a north-easterly direction, we enter the Mun Valley. We here find, first, low hills of sandstone crowned with considerable quantities of rust-coloured rounded stones, which have apparently been subjected to heat. In some of these hills I remarked that the pebbles formed a distinct bed again capped with sandstone. They contain an inconsiderable quantity of iron, and have much the appearance of having been ejected from a volcano. They are often fissured or hollow, or containing red and yellow ochre, and occasionally sulphur, and even sand. There are no distinct volcanic rocks in the neighbourhood, but I noticed to the westward some small conical hills which I was unable to visit. We next meet with a low range of hillocks distinctly stratified, dipping at about 6° south, composed of a cemented dark-coloured gravel, with considerable quantities of fossil bones imbedded; the bones exist in great numbers, and some were so large and heavy that I found it impossible to carry them away. Proceeding across the valley in a northerly direction, sandstone hills crowned with the same rust-coloured round stones are again found, and it is to be remarked that the nummulitic boulders are also spread over these hills. Proceeding about a mile farther north, we come upon a thin seam of boulders conglomerate resting on nummulitic limestone; the boulders are evidently rolled and waterworn portions of the nummulitic limestone beneath. I observed this conglomerate in many other places of considerable thickness, and I have reason to think that all the boulder and gravel overlying the sandstone hills and outer valleys were derived hence. At Trukkee this conglomerate attains a considerable thickness, amounting to several hundred feet; in other places it is replaced by the sandstone resting directly on the limestone.

Next in descending order comes the nummulitic limestone *in situ;* its usual colour is a very dark blue, in some places changing to a grey, and in others, as at Doza Khooshtie, a pale yellow, and is then arenaceous. In some localities where a deep section was exposed, I remarked that the limestone became slaty in its structure, and contained fewer of the nummulites and sometimes none. In this lower portion there are fine specimens of a species of *Cancer;* I have been as yet unable to refer it to any described species. The dark blue variety of limestone is intensely hard and sonorous, and has apparently been exposed to considerable heat, by which the calcareous matter of the shells has been volatilized, leaving nothing but casts. This limestone is of great thickness, and is the rock which constitutes all the higher ranges of mountains in this part of Beloochistan.

There are four parallel ranges of mountains formed by this limestone, running nearly east and west, the most northern of which visited, viz. the "Murray range," is the highest, and I imagine reaches an elevation of about 3,500 feet above the sea. The rock is easily identified, whenever it occurs, by the vast number of nummulites it contains, and by its other fossils : the low rocky hills upon which Roree and Sukken are situated are an outcrop of the same limestone containing similar fossils, and in colour resembling the pale arenaceous limestone of Doza Khooshtie. At the upheaving of the limestone a number of deep clefts seem to have been formed, mostly running north and south, or transverse with respect to the mountain ranges : many of these do not exceed ten feet in breadth,* but equal in depth the mountains in which they are formed. That they were not formed by the erosive action of water is apparent, because the salient points on one side (and the fracture is still sharp) have their re-entering points on the other ; and in fact a convulsion of nature might again close them, in which case they would dovetail and fit exactly.

All the mountains in this part of Beloochistan exhibit the same effect of great disturbance, and much of the drainage of the country is at present effected through such fissures. The range to which the name of 'Trukkee' is applied is the most remarkable in this respect. These clefts extend even to the sandstone of the outer ranges ; but

* The breadth of some is even less than I have stated.

the rock being there of a more yielding nature has suffered from the action of the elements, and the clefts (or passes) are wider while the limestone usually exhibits them in their original sharp escarpments. I have reason to think that this nummulitic limestone extends over a very large tract of country, specimens brought from the vicinity of the Tukht-i-Sulliman having been shown to me by Lieut. Cunningham of the Bengal Engineers, which certainly belonged to the same formation. A similar rock is used for architectural purposes at Cantuel, and it takes, I was told, a tolerable polish. At Num, where I first came upon this limestone, it dips at about 20° south, passing in that direction beneath the conglomerate and sandstone, about a mile and a half farther to the north. At the pass leading to the Deyrah Valley there is a remarkable slip or fault of the limestone strata, the dislocation amounting to about 300 feet. The limestone at the base here dips at about 20°, that above being nearly horizontal; and at the upper margin of the fault there are some of the strata hanging at various angles. This fault extends east and west of the pass for many miles.*

From this pass, proceeding north, the stratification is nearly horizontal as far as Coombe, a place about 2,100 feet above the sea. From Coombe, in a northerly direction, the limestone gradually obtains a dip to the north, amounting at its base to about 20°, and then becomes lost beneath low sandstone hills. I was unable on the line of march to give these interesting sandstone hills the examination they merited; they are composed of various-coloured sandstones, with the strata dipping in a northerly direction at about 10° or often less, thus corresponding so far in dip with the limestone; but the point of connection between the latter rock and the sandstone escaped my observation: this is to be regretted, as the subject is one of importance. These hills are interesting from the vast quantity of fossil bones and fossil wood which has been entombed within them; both are scattered about in vast profusion, and many cart-loads of the bones could be collected from off an acre of ground.

The wood bears the appearance of having been drifted and waterworn previous to fossilization. I noticed palms and dicotyledonous

* The point of fracture exposed is highly glabrous, as if it had been exposed to a grinding action.

trees, one of which had a structure resembling pine; some of the broken stems had a diameter of two feet, and the quantity exposed upon a small area was truly wonderful. I could only collect as many of the bones as I could carry on my own person, but amongst these are bones of the mastodon or elephant, portions of the tusk of the same (no molars were observed), part of the jaw of hippopotamus, various bones of crocodiles with broken jaws of the same, and many others which it will take time to make out. Thus it would appear that on the northern and southern base of this limestone range (the first proceeding northwards from the Desert), there are strata having the same character, and that in both places similar fossil bones are found imbedded in a loosely cemented gravel, containing shells of *Paludina* and *Cardium*.

About five miles to the north, advancing towards the Deyrah Valley, a deep-bedded boulder conglomerate is met with; and one mile further the nummulitic limestone again crops out, the strata dipping north at about 45°. This range of limestone forms the southern side of the Deyrah Valley, and, it will be observed, dips into it; at the base it supports a stratum of conglomerate, which is lost in the valley.

The Deyrah Valley stretches nearly east and west, corresponding with the mountain ranges; its mean breadth is about four miles, and its length perhaps forty miles. The soil is alluvial, and is in many places covered with boulders of nummulitic limestone.

The northern side of the valley is flanked with a range of hills composed of stratified boulder conglomerate. The boulders are nummulitic limestone, and the strata dip into the Deyrah Valley at angles varying from 20° to 35°: the northern aspect of this range is precipitous.

Immediately north of this conglomerate there is a very narrow valley abutting at the foot of the Trukkee nummulitic limestone range; this valley is broken by many small hills of a conical shape, composed of calcined clays of various colours, containing sulphur and scoria; and these seem to have been volcanic vents emitting gaseous vapours, and perhaps occasionally ejecting stones, but never lava. No igneous rocks exist in the country visited, nor is any rock older than the nummulitic limestone to be found.

The Trukkee range, at the foot of which these appearances are presented, is composed entirely of nummulitic limestone, and attains an elevation of about 3000 feet above the sea. The strata dip southwards towards the Deyrah Valley at angles varying from 45° to 60°, and they form a continuous mural barrier or a natural fortification on a stupendous scale, through which there are many passes formed by clefts in the manner noticed above. I traced this range holding the same mural character for about seventy miles from east to west: and I also noticed other ancient conical hills at its base, about twenty miles east of Deyrah. Near the foot of the same range, at Kissooker, there is a tepid spring. At the time I noted its temperature the air was 70° and the spring 71° of Fahrenheit. There are other tepid springs in these hills, one of which at Doza Khooshtie bursts up through a fissure in the limestone; but I did not note its temperature. From the appearance of the limestone, which in many places at Doza Khooshtie is rapidly disintegrating, and from some calcined clays which I noticed, there is little doubt that an old volcanic vent existed in that neighbourhood.

The Deyrah Valley requires further notice, and appears to have been formed by subsidence; but however that may be, I am certain that the conglomerate at one time rested on the limestone, because there are still detached portions of it resting conformably on the limestone. The opposite or southern side of the Deyrah Valley exhibited the same evidence, although not so distinctly, and a beautiful section of the limestone is seen in the pass or cleft through the Trukkee Hill. The floor of the pass is on a level with the base of the mountain, and the higher (outer) strata are full of fossils; but moving onwards through the pass and towards the north the limestone becomes of a lighter colour, and further on obtains a slaty stratification containing few fossils. From this point to the Murray Hills there are numerous confused and broken hills, at a lower elevation, which have undergone great disturbance, but I was unable to inspect them closely.

The Murray Hills are composed of nummulitic limestone; they present a precipitous escarpment to the southward, and the stratification is nearly horizontal. The range is higher than any of those between it and the Desert.

No minerals of any account were met with. Sulphur and alum exist, but not in sufficient abundance to be of commercial value; but alum is worked further to the eastward, although not in the district visited. Iron exists in small quantities; iron pyrites abound in nodular masses in the limestone, and there are gypseous veins at Doza Khooshtie. When noticing the pale yellow variety of limestone, I forgot to mention that it often contains nodular, ramified or tabular masses of flint, which frequently manifest a resemblance to stems of marine algæ and sponges. Doza Khooshtie and Trukkee are two remote points which exhibit this formation. A white marble, which would answer for statuary purposes, is found in the Trukkee range.

The aspect of the country is barren in the extreme, but in some places there is sufficient soil to repay the cultivation. Near the anticlinal axis of the first limestone range the disintegrated limestone forms a good soil, which has been cultivated. The alluvium of some of the valleys is also fertile, particularly that of Deyrah. The native plants of this region are peculiar, but few in number, not exceeding 200 species.

The hasty examination given to these mountains will, I hope, be a sufficient apology for many defects in the details now furnished. It requires more time than a marching soldier can command, to follow out fully a geological inquiry in a broken and mountainous country. It happened more than once that I passed over most interesting ground during the night, and even in the day time other duties often required my undivided attention.

I cannot close this report without tendering my sincere thanks to His Excellency Major-General Sir Charles Napier, G.C.B., for the assistance so liberally afforded in giving me carriage for my specimens,—an instance of regard for the interests of science rarely manifested in India.—*From the Quarterly Journal of the Geological Society.*

On the Remains of Infusorial Animalcules in Volcanic Rocks. By C. G. Ehrenberg.

The influence of animalcules (or organic bodies so minute as to be invisible to the naked eye) on the formation of the actual solid masses which make up the earth's crust has only lately been recognised, even with regard to the newest stratified rocks and those of the most recent geological period; but amongst these the so-called mountain meal, peat, sea and river-mud, bog-iron, the earth in which the mineral *Vivianite* occurs, and others, are now known to be either partly or entirely composed of the organic products secreted by these little animals.

A similar origin must however now be assigned to those tertiary rocks which are known by the names tripoli, polishing slate and semi-opal, to some of the porcelain earths, to the so-called *dysodil*, and to the paper-coal of the brown coal formation; and even among the upper secondary rocks we find that the greater part of the white chalk, the nummulite and catacomb limestone of Egypt, the firestone of the same period, and several of the chalk marls, are, beyond question, the direct products of similar minute organic beings.

Amongst the middle secondary rocks again, we find that the hornstone of the coral rag of Cracow, and some widely-spread oolitic rocks in various parts of Europe exhibit distinct traces of a similar origin; while even in the newer palæozoic rocks we learn from Count Keyserling and Prof. Blasius that there is a compact limestone of the carboniferous period near Lake Onega in which these little organic bodies are present in vast abundance, associated with a species of Bellerophon.

The hornstone of Tula also, considered and described by Helmersen as mountain limestone, and in which *Choristites mosquensis* is present in great beauty, has certainly been formed for the most part by these microscopic animalcules; and it is not long since Prof. Bailey of New York forwarded to Europe specimens of a hornstone from near Madison, Wisconsin U. S., considered by the American geologists as belonging either to the carboniferous or oolitic group; and this M. Ehrenberg on examination has found to be also entirely

composed of similar remains, and to resemble very closely the formation of carboniferous limestone from Lake Onega.

Amongst the stratified fossiliferous rocks therefore, it remained only to exhibit similar relations with regard to the lower palæozoic rocks, where however the difficulty arising from the great amount of chemical change such rocks have undergone, destroying the vestiges of these minute creatures, besides the opaque and troublesome character of the rock itself, renders the negative result at present obtained little to be depended on. It is very possible that in the lowest of the series of deposited rocks such minute bodies have suffered change, but it is also highly probable that they have occasionally been preserved, owing to some favourable circumstances, and may therefore still be discovered.

Beyond these limits it has been hitherto considered that all our investigations must necessarily cease, the field of observation seeming to be completely shut out in those cases where volcanic forces have come into play. The calcareous rocks when exposed to heat soon lose all indications of their having been formed by organized beings, and the siliceous earth, when burnt in association with clay, limestone and particles of iron, passes into a kind of glass, which, whether compact or cellular, has the character of an entirely inorganic mineral. It also appeared that the great depth at which it was supposed volcanic products must be elaborated, rendered it impossible that any of the results of organization should be effected by or should affect them.

It is indeed several years since M. Ehrenberg stated to the Academy that the polishing slate and *Kieselguhr* (siliceous sinter), as well as the so-called volcanic ashes or porcelain earth of volcanic districts, might be considered as actually made up of the remains of these little animalcules; but in the various places whence the specimens had been obtained (near Cassel, the Caucasus, the Isle of France, &c.) it seemed probable that they had been developed in great abundance during the intervals between volcanic eruptions, the crater under such circumstances becoming a small lake in which these animals lived and increased rapidly, and deposited their flinty skeletons, another eruption after a time drying up the bed of such a temporary lake, and covering it up with erupted ashes, which also in their turn

afterwards became the receptacle of a similar deposit. This it was thought might go on until a more powerful and energetic upheaval of the bottom of the crater either gave to these strata a steep inclination or fairly lifted the concave bed into a convex dome, thus precluding any further repetition of the process. It appeared, indeed, from an examination of its internal structure, that the hornstone-like and glassy semi-opal was not formed immediately by volcanic agency.

Two other cases in which microscopic animalcules were associated with volcanic rocks had also been noticed by the author, but in these the conditions were less distinctly marked than in the former. One of them had reference to the red firestone of the north of Ireland, which has apparently undergone fusion, and in which some of the chalk infusoria are distinctly present; and the other was the edible earth of the Tungusians, from the Marekan mountains near Okhotsk, of which M. Ermann, jun., had brought specimens. So long ago as in March 1843,* the author had stated that in this edible earth, which appears under the microscope to consist almost entirely of pounded pumice, there were three distinct species of known siliceous Infusoria† and one of Phytolitharia.‡ M. Ermann considered, from the circumstances under which it occurs, that the edible earth consists of a very fine, dry and meagre dust of pounded rock, in which this strange association of infusorial animalcules has unaccountably become mingled ; and the author admitted such an explanation, describing the species as offering a remarkable instance of geographical extension, whatever be the relation in which they stand to the rock or formation. The recent investigations with regard to pumice give a new interest to this remarkable fact, and take away from its apparently anomalous character by showing that there is no necessary relation of the organic remains in question to the rock or deposit called *Marecanite.* With regard to the other instance mentioned, that of the fused firestone, it appeared to possess little general interest, since the rock containing the remains might easily

* Monatsbericht, p. 104.

† *Fragilaria amphicephala, Gaillonella distans,* and *Tabellaria vulgaris.*

‡ *Pilus plantæ.*

have become associated with the lava in which it was found, fragments of the adjacent rock existing in it in considerable number.

The only example of any distinct relation of microscopic organic bodies with recent volcanic phænomena was one recorded by M. von Humboldt, and occurring near Quito, where an extensive volcanic mud-eruption distinctly presents the phænomenon of minute organic bodies, especially those of vegetable origin, proceeding from the interior of a volcano, apparently from a great depth and in direct association with those volcanic effects which have upheaved mountain masses.

It has however lately become an important object of investigation to learn where we are to seek for the first traces of organic life, and although for some time calcareous rocks have alone been considered as affording distinct evidence of its existence, on account of the change effected in the siliceous parts of infusorial animalcules in fused rocks, the anticipations of the author that these remains were more permanent than had been supposed, are fully borne out by the facts about to be recorded, since he is now able to announce that pumice both in its normal state and in powder, volcanic tuff, volcanic conglomerate, trass, decomposed porphyry and porcelain earth or volcanic ashes, as well as clink-stone, and apparently the crumbling marecanite-tuff, besides the various volcanic fused and erupted rocks, have one after another and in rapid succession been found to exhibit a direct and necessary relation with the most minute forms of organic existence, and that such is the case from whatever part of the earth these rocks are obtained.

The progress of the investigation is as follows:—

A specimen of very white siliceous earth of loose texture and small specific gravity, obtained from the foot of the volcano 'Hochsimmer' near the lake of Laach on the Rhine, was in July 1844 forwarded to the author by Prof. Nöggerath of Bonn for microscopic investigation, the specimen being suspected to contain infusorial remains. It appeared on examination that the whole mass, with the exception of a few grains of quartzose sand, consisted of siliceous infusorial cases, while the peculiar association of species and their diminutiveness, and especially the remarkable preponderance of *Pinnularia viridula,* induced the author to conclude that there existed

some peculiarly interesting relations of the beds; and he expressed a wish that a strict local investigation might be carried on with respect to some at least of the peculiar species obtained. M. Nöggerath at once undertook to do this, and in the month of August the author received specimens obtained from M. Spenler of Mayen, but the original pits were at that time filled up, so that this first investigation was not satisfactory as regarded the locality, and it became necessary to have the pits re-opened. The specimens however which were forwarded were such as to induce the author to wish for a yet further investigation concerning the local relations, since in some of them the infusorial earth appeared to be most intimately and strikingly mingled with volcanic tuff.

In the months of August and September his investigations on these rocks were for a time suspended during a journey made by the author into Bohemia, where he had the opportunity of observing similar phænomena in the field and on a grander scale.

On this occasion he examined the vicinity of Bilin in company with Dr. Reuss, and found that volcanic action had there produced great disturbances and disruptions of the stratified rocks, which rendered it very difficult to determine, at least during a hurried survey, the original relations of the superficial phænomena and the date of the metamorphism. The Bilin infusorial polishing slate is however clearly a stratified rock, having relation to the other formations, for it is seen at the top of the Kutschliner mountain, whose principal mass is gneiss, and which is surmounted first by a thickness of about twenty-five fathoms of a cretaceous marl belonging apparently to the Pläner-kalk, and then by about ten feet of clay containing ironstone balls. The infusorial mass, which on the whole is about fifty feet thick, surmounts this clay, and presents the appearance of a mammillated slate, a polishing slate, or a semi-opal, according to its degree of hardness. Dr. Reuss' sections have rendered all this perfectly clear. The author endeavoured to find some springs of water which might have produced these phænomena in modern times, but there was no trace of a spring on the bare barren summit, nor could any channel be discovered on the declivity down which such spring might have poured. But the amphitheatre which the form of this isolated hill presented was extremely striking. Many

delicate well-preserved organic remains of animals and plants,* some of them known, but some belonging to species now extinct, distinctly prove that this polishing slate belongs to an ancient division of the tertiary period, immediately subsequent to the chalk, and at the same time that it was a quiet deposit in fresh water, exhibiting by its organic remains a gradual passage from the animal to the vegetable kingdom. The thin superficial coating of gravel seems to show that the whole has been since subjected to the action of currents of water.

The environs and the springs of Töplitz and Carlsbad were also objects of investigation during the author's brief stay, and he looks forward to a time when he may be able to follow out these investigations in greater detail; but he was particularly struck with the large crater-shaped valley of Franzensbad, whose diameter is about four miles, and within which is the little volcanic cone of the Kammerbühl. In this spot were exhibited many highly interesting conditions and relations, of the most minute forms of organic existence.

It was evident from the first glance that the infusorial siliceous earth played a very important part in the valley of Franzensbad. That it was indeed by no means a mere local phænomenon exhibited in the little hillocks or heaps on the surface, as had been originally supposed, but existed as a regular and extensive deposit beneath the coating of vegetable soil, had been noticed before by Dr. Palliardi, but the author observed its extension in so many places besides those noticed by Dr. Palliardi, wherever the denuded surface was visible, and it appeared to be so completely an integral part of the turf or bog earth, that the whole valley seemed completely covered with it, and in fact the whole of the turf, whether its thickness is one or twenty feet, belongs more or less exclusively to this formation.

Near Franzensbad the development of *Pinnularia viridis* in great masses of siliceous earth is extremely striking, and at the east end of the valley the presence of *Campylodiscus clypeus* is equally abundant

* There is an extremely rich and beautiful collection of these in the museum in the Lobkowitzian palace, but the specimens have not yet been described.

in the same manner. Similar formations were observed by the author to be still in progress, but the great mass of the deposit consists of the mere empty infusorial cases. Scarcely less extensive than these are the deposits of massive carbonate of iron in the neighbourhood of the acidulous springs, which commonly, but not always, contain fragments of *Gaillonella ferruginea*. In the midst of the true siliceous infusorial earth there also occurs phosphate of iron in the form of blue vivianite, above which the fen-mud appears, and is often quite filled with and hardened by the black iron pyrites.

Here however it will be seen that neither the mineralogical nor the physiological conditions are wanting for the combination of the materials, and the black pyrites is manifestly a local and subsequent formation. Whether indeed the sulphates of soda and lime in the water have received the excess of carbonate of iron after the formation of the pyrites, or whether the *Gaillonella ferruginea* has absorbed sulphuric acid given off after death by the bodies of the siliceous-shelled animalcules, the author leaves it to other naturalists to determine, but he expresses his belief that the vast multitude of microscopic animalcules at Franzensbad have had a direct and important influence on the local peculiarities observed in that neighbourhood.

By such investigations the volcano in the neighbourhood came to be viewed in a new light. It rises from the plain with a gentle inclination on the eastern side, but to the west there is a nucleus of cellular basalt or basaltic lava-slag rising to the summit; the formation in the neighbourhood is mica-slate. The whole of the eastern dome-shaped slope forms a stratified heap of light volcanic erupted ashes, often containing lumps of some size and also very small fragments of mica-slate, quartz, or white pumice. The impression made by viewing these phænomena was, that the eruptions of cellular lava and slag, and consequently the whole slope of the hill, consisted of nothing more than a valley or the bed of a lake of volcanic origin, which existed before the outburst of lava, but that the valley was not destroyed by the eruption, and received no elevation. Several experiments were made with a view of confirming this impression, and with regard to the stratification of the ashes it

appeared not necessary to assume any subaqueous action and subsequent elevation, or any subsequent covering by water, since they most resembled the great rubbish heaps near Cahira in Egypt and elsewhere, which exhibit the same appearance of regular stratification, and have been formed without water.

The idea therefore of a relation between volcanic action and the conditions of existence of the most minute organic beings ceased to be a mere vague speculation, and some proof of its correctness was presented by gradual successive steps in investigation.

On his return from his summer excursion, the author found an admirable and systematic collection from his correspondent at Bonn. The first glance of these under the microscope showed their nature, and the investigations at Hochsimmer have gradually led to the following results.

The infusorial polishing slate occurs on the eastern slope of the Hochsimmer (about four miles from the Laacher-See), between the roads which branch off from Ettringen to St. Johann and Waldesch. It is interstratified between beds of pumiceous conglomerate.

Immediately under the vegetable soil we find—

	feet.	in.
1. Ferruginous pumiceous conglomerate......	8–10	0
2. Volcanic tuff	1	0
3. Infusorial stratum (polishing slate)	0	2–3
4. Finely-grained pumice conglomerate	0	2–3
5. Coarse pumiceous conglomerate which has been penetrated to a depth of...........	3	6
Total thickness....	12 ft. 4 in. to 15 ft.	

The lower pumiceous conglomerate evidently reposes on the grauwacke, which with clay-slate forms the underlying deposit in the neighbourhood. The beds of volcanic conglomerate which enclose the infusorial polishing slate have a considerable dip, amounting to 20° north-west, and their thickness appears in some places to amount to as much as twenty-four feet, but the bed of polishing slate nowhere exceeds three inches. The upper covering seems to form

part of a grey basaltic lava-stream proceeding from Seelsberg. The author was indebted to M. von Dechen for this information.

A careful microscopic examination gave the following singular results with regard to this locality :—

First :—Not only is the stratum of polishing slate entirely made up of the siliceous cases of infusorial animalcules, but the beds associated with it, consisting, as we have seen, of volcanic tuff and pumiceous conglomerate, are composed in great part of the same substance.

And secondly, the tuff and pumice conglomerate exhibit the infusorial cases in a distinctly fused condition, resembling that noticed by the author in some investigations made several years ago on infusorial earth that had been burnt for tiles or porcelain.

Thirty-eight species of microscopic infusoria were determined by the author from the Hochsimmer beds, and it seemed probable that many more might be added to the list; of these species, however, only two are new, and of the remaining thirty-six, one has hitherto been known in Europe only as a tertiary fossil, but all the rest are living European species.

Before extending his investigations further in the determination of additional species from this locality, the author thought it advisable to advance in another direction, and since the very fragments of volcanic rock themselves had exhibited these organic remains, he availed himself of M. Krantz's collection at Berlin, and selected several different kinds of pumice for examination. He thus obtained a number of specimens of volcanic ash or trass from Brohl on the Rhine, and he afterwards also obtained specimens of similar tuff from Civita Vecchia, and from Posilippo near Naples. All these he carefully examined.

The result was very striking, since the nature of the pumice was apparent everywhere, and exhibited not merely that peculiar cellular structure which reminds the observer of fused specimens of *Gaillonella*, but every minute fragment, even from the very middle of the mass, exhibited more or less distinctly the contained forms, and a number of species was soon added to the list of those contained in pumice.

The next step in the investigation involved the examination of specimens of pumice and similar volcanic rocks from the Royal Mineralogical Collection at Berlin, which is exceedingly rich in various departments of scientific mineralogy, and here the author first turned his attention to the Manilla specimens, partly on account of the wide extension of the volcanic tuff there said to exist, and partly because from this locality an infusorial polishing slate had already been brought by Prof. Meyen. The result of this examination was unexpected, but at the same time instructive, since it taught that the object sought for was neither everywhere present in the same form nor everywhere manifest without some trouble, even when it existed in that form. Under such circumstances it appeared that a special examination might be necessary; the Manilla tuff, however, did not exhibit any infusoria.

Although however this was the case, M. Meyen's collection furnished a pumice from Santiago in Chili, marked 'Tollo,' and fully described in his 'Travels' (vol. i. p. 338). This pumice forms a steep and almost isolated hill 300 feet high, near the volcano Maipu, at whose foot lies Tollo, 3600 feet above the sea. In this pumice the author found three species of siliceous-shelled infusoria.

Further investigation showed that a rock at Arequipa in Peru, near the volcano, and described by M. Meyen as being probably a decomposed porphyry, was in fact a true infusorial polishing slate. Several decomposed porphyries are also mentioned as occurring in this neighbourhood, one of which is a hard specimen about five inches in length, from Cangallo near Arequipa,* from which as many as eighteen species of siliceous-shelled infusorial animalcules and twelve species of Phytolitharia have been obtained. Of these, two of the latter group are identical with those found at Santiago, but the third is not among the thirty Arequipa species.

The author considers it right to add that he has examined several specimens of pumice without finding in them infusorial remains, but he states that the trouble and difficulty of recognising them was at

* This spot is 7753 feet above the sea, and is a volcano, which, according to Meyen has never erupted lava, but always pumice.

first exceedingly great. Amongst the instances however in which his labours were rewarded with success was that of a specimen in the Royal Mineralogical Museum, obtained from Mexico, marked 'Tisar, clay-slate and siliceous earth.' It consisted of a white substance from the vicinity of a volcano, and proved to be an almost pure infusorial polishing slate, in which thirty-three species of polygastric infusoria and five Phytolitharia have already been made out.

These two beds of fossil infusoria from South America and Mexico were the first observed from that locality, and are interesting not only by their direct relation with recent volcanic action, but also because they show the conditions under which we may expect to find the material in which further investigations of this kind may be expected to be successful.

The following are the general results of his investigations, as stated by the author at the close of his first communication :—

1. We have presented for microscopic investigation infusorial masses that have been fused by exposure to volcanic fires.

2. Beneath the fused masses of infusorial remains other masses are found resembling polishing slate, but containing none of those remains elsewhere common, which are capable of being dissipated by exposure to moderate heat.

3. It appears that from the depths of a volcano masses of organic bodies have been thrown up, which either, as at Moya in Quito, contain imperfectly carbonized vegetable remains, or, in the case of more complete fusion, exhibit similar forms imbedded in pumice or tuff. With regard to the peculiar change produced by fusion, it does not seem possible that the effect can have resulted in any other way, or by foreign organic bodies penetrating the rock while moist, and soon after its formation, since the appearance is peculiar, and can be brought about by artificial means.

4. Organic remains have not been met with in all kinds of pumice; and only those appear to have been formed out of the infusorial cases where there has been no powerful flux present to reduce the mixture to the condition of glass. It will require further investigation to determine the relation of Obsidian to these pumiceous formations.

5. In the vicinity of many volcanoes which either have erupted or do erupt chiefly pumice, there are great deposits of infusorial animal-

cules, which under the names of porcelain earth, volcanic ashes, siliceous sinter, polishing slate, mammillated slate, semi-opal and decomposed porphyry, have been considered, and generally without sufficient reason, as having a direct relation to the volcano. Such is the case in the Isle of France and the Isle of Bourbon with the porcelain earth and volcanic ash; and also near Cassel, near Cayssal in the Puy-de-Dôme and in the Caucasus, and is recognised again in the case of the polishing slate near Bilin, where the polishing and mammillated slate and semi-opal are found, and at Arequipa in Peru with the rock described (but falsely) as decomposed porphyry. Other similar deposits however, as for instance that at Luzon near Manilla, that near Mexico, and those near Eger and Franzensbad, appear to have no reference to volcanic action; and to this class also belongs the recently discovered polishing slate of the Laacher-See.

Of the infusorial deposits however, which are distinctly the result of volcanic activity, and have sometimes been brought up and erupted from great depths, we have several examples:—1st, that of Hochsimmer near the Laacher-See (perhaps not erupted, and only exposed to the action of heat); 2ndly, the trass of the Brohl Valley (supposed by those on the spot to be the site of an ancient volcanic eruption), and the similar beds from Lummerfeld; 3rdly, the tuff of Civita Vecchia near Rome; 4thly, the pumice of Tollo, near Santiago in Chili, belonging to the Maipu volcano; 5thly, the pumice from Kemmerbühl near Eger; 6thly, the marecanite tuff near Okhotsk; and also, 7thly, the same rock at Moya near Quito.

6. At Hochsimmer there is also a formation resembling phonolite, the component parts of which have the closest relation with siliceous-shelled animalcules.

7. It is extremely remarkable, that in all the various instances, whether in Europe, Africa, Asia or America, in which microscopic organic bodies are seen to exist in direct or approximate relation to extinct or active volcanic action, all of these belong exclusively to fresh-water formations.*

8. It appears to result from this review of the phænomena, either that in the great depths beneath the surface there are ancient de-

* In the subsequent part of this article it will be seen that an exception to this has been found.

posits, perhaps of coal, formed under conditions remarkably similar to those now existing; or else, which is more probable, that these immeasurably great masses of tuff, pumice, trass and mud, erupted from volcanoes, have been sucked in by the volcano from time to time, in the form of existing turf and bog, or fen-mud, greatly assisted perhaps by the vicinity of freshwater lakes and pools of water; and then having been partially fused are thrown out again during the next eruption.

9. The invisible portion of the animal kingdom is thus found to possess a new, important and unexpected influence upon the solid, and in this case volcanic portion of the earth,—an influence which invites a closer investigation, and recommends itself to universal attention.

On the 24th of April 1845, Professor Ehrenberg made another communication to the Academy, stating the result of further investigations into the subject, partly with reference to some additional specimens from Hochsimmer, and partly on various volcanic tuffs, &c. from distant localities.

I.—*On the Volcanic Infusorial Tuff* (Pyrobiolite) *of the Rhine.*

Owing to the active researches of the local authorities, and especially of M. von. Dechen, the author has obtained much new information with regard to the Laacher-See and Hochsimmer; and he states that, including a firestone forwarded by M. Noggerath, not less than thirty-nine different kinds of rock had been forwarded to him for investigation. The geological relations of these rocks he considers it highly essential to record; and they are the more important, since other objects had been forwarded to him for examination from distant localities, and a comparison of the results with what we know of the volcanic relations of the inland Rhine district would tend to a completion or rapid extention of our general knowledge of the subject.

The sections at Hochsimmer are obtained from six points; and the following account is quoted by the author from a communication he had received from M. von Dechen:—

"The first result is, that the peculiar infusorial mass is not confind to the one stratum first made known, although the others recently laid bare do not equal that in purity and regularity.

"From the relations of the originally exposed infusorial stratum, the immediate deposit of the whole series of volcanic tuffs and conglomerates containing that bed, and resting upon the grauwacke, is distinctly seen.

"The thickness of the conglomerate and tuff, as far as it has been hitherto proved, amounts to about $27\frac{1}{2}$ fathoms or 165 feet; and it is not likely that the whole thickness is much greater than this, since the grauwacke comes out to this day at no great distance towards the north-east.

"Notwithstanding that the whole thickness of the deposit has not been penetrated at this point, there is no doubt that the series of deposits upon the grauwacke consists exclusively of various conglomerates and tuffs of volcanic origin, having very different thickness, and containing, interstratified with them, several infusorial masses; and the whole sequence is essentially identical with the very similar series in the neighbourhood of the Laacher-See."

The microscopic investigation of the thirty-nine specimens forwarded has led to the following results:—

1. The whole stratified deposit of volcanic tuff and conglomerate reposing on the grauwacke at Hochsimmer, just as in the case of the Brohl Valley, and the similar masses on the east bank of the Rhine (*e. g.* the pumiceous conglomerate or sandstone of Engers), all exhibit relations with minute organic life, and are often, to all intents and purposes, actually formed of microscopic animalcules.

The relation with organic beings is of this kind: not only are there complete layers of distinctly recognisable organic bodies, which were once the siliceous cases of infusorial animalcules, but, with few exceptions, every fragment of tuff not larger than a pin's head will be found to contain several portions, sufficiently preserved to enable us to identify specific forms, and often exhibit complete shells of these minute beings; sometimes also the whole mass is almost entirely made up of them.

In the rock at Brohl and the firestone of Bell, it is the included pumice which exhibits remains of this kind either complete or in a

fragmentary state; and in the pumiceous conglomerate, or, as it is called, the sandstone of Engers, it is not the grey interstratified mass, but the white pumice-like nucleus of the conglomerate, which also here and there contains similar organic bodies though in a fragmentary condition. Many of these in the regular volcanic tuff formations appear to have become quite unrecognisable; but amongst the mass some may often be found which enable us to determine both the genus and species of the little animalcule of which they are the remains.

In most of these volcanic tuffs one may often perceive, by using transmitted light, green, brown or white crystals, of which the green are for the most part columnar, oblique-rhomboidal, acutely-pointed prisms, appearing black with reflected light, being in all probability crystals of augite, while the obtuse brown crystals are more likely to be hornblende. Many of the tuffs contain great quantities of exceedingly small white transparent crystals in which sometimes there may be distinctly traced the rhombic-dodecahedral form, and these no doubt are sodalite, or perhaps occasionally leucite.

2. The masses thus characterized appear to be, as they have always been considered, of volcanic origin. The numerous small crystals of augite which make up so large a part—often at least one-half of the whole mass—and those white kernels and particles of sodalite and leucite visible to the naked eye, have hitherto been considered as the result of the action of heat, since we are not aware of the possibility of such forms of the mineral being producible by aqueous action. The application of the microscope to this subject, showing that the condition of the siliceous infusorial cases is such as would be the effect of exposure to very high temperature, has fully confirmed this view.

3. The stratified mass at Hochsimmer can no longer be considered as an aqueous formation, fused into a mass by volcanic action immediately after its deposit; since the condition of the different strata is not such as would be produced by such means. Several experiments seem to prove that the most perfect fusion has been effected in portions which are by no means the lowest in position.

4. The tuff of Hochsimmer could not, it would seem, have been formed under water, because, the materials of the strata are not

arranged according to the law of gravitation. The author states that he has made out, by direct experiment, that the white, siliceous, infusorial powder by no means retains its white colour, nor does it arrange itself in the same way after being mixed under water with the fine tufaceous ash with which it is interstratified. The hollow cells also of these infusorial cases rise to the surface when mixed with coarse particles, so that some other cause than mere deposit from water must have produced the alternation of fine layers of these with beds of coarse tuff.

If it should be said that these coarser particles of tuff, amongst the fine layers of infusorial animalcules, consist of concretions which have formed in water from the more minute particles since the mass was deposited, or that they have been formed at all by aqueous action, the association with volcanic crystals, sometimes of considerable size, renders such an explanation impossible. In the same way it seems impossible to account for the appearance by supposing that the masses containing infusoria were deposited regularly in alternation with deposits of tuff, because the internal structure and composition of the tuff itself, and the fact that it is often partly and sometimes almost entirely made up of similar organic bodies, is directly opposed to such a view.

But again, it may be imagined that the infusorial animalcules were introduced after the volcanic deposits had been effected, and partly by aqueous action. To this idea, however, is opposed the fact of their being almost always in fragmentary condition, and in great part metamorphosed,—an appearance which the author has never seen in the rapidly forming beds of these animal remains, either in Berlin or in the Luneburg forest, or near Eger, however thick the deposits may be. The regular stratification and distinctly arranged appearance are also opposed to this view; and indeed it becomes altogether impossible, when we consider the mingling that there is of Phytolitharia—the siliceous particles of certain minute vegetable bodies—which could as little form and increase in these places, or even penetrate to them, as the bones of quadrupeds.

5. The Löss in the Rhine neighbourhood appears quite distinct from the tuff, although it contains parts made up of organic bodies. It bears no appearance of having undergone the action of heat.

6. There are at this time ninety-four different species of microscopic bodies recognised as forming an integral part of the Rhenish volcanic tuff; and of these seventy-two are *Polygastrica* and twenty-two *Phytolitharia*, and all without exception consist of land or fresh-water forms. Only four or five of the whole number are unknown and peculiar.

7. With regard to the particular species, the author remarks that the toothed *Eunotiæ*, viz. *Eunotia triodon* (having three teeth) and *E. Diadema* (with six teeth), have not hitherto been met with by him in a living state in Germany, and are generally considered as northern fossil forms in Sweden, Finland and North America. The first of them was however found living near Salzburg by the late Dr. Werneck, and has recently been recognised in atmospheric dust from the Cape de Verd Islands. There are also three species of *Biblaria* not now known to exist in Europe.

8. Among those whose remains form great masses in the Rhine district may be enumerated *Discoplea comta* and *Pinnularia viridula*. The first is only at present known as an existing species on the high lands of Koordistan, but the other is common in a living state every where in the vicinity. The *Discoplea* occurs also in the phonolitic incrustation of Hochsimmer and at Wistershan in Bohemia, and is also present in the ashes which have buried the ancient city of Pompeii; and a very similar species is found in the tertiary tripoli of Virginia; it is closely allied to *Gaillonella crenulata*.

The author mentions that he has seen and carefully avoided errors of observation arising from the resemblance of some forms of infusorial cases to fragments of crystalline bodies, such as sodalite and leucite, which are often present, and might readily be the cause of mistaken descriptions.

9. If, after a further extension of our knowledge as to the circumstances of the case at Hochsimmer, it should appear possible that this deposit might have been formed by a shower of ashes, or by projectiles consisting of a fine dust fused together into a mass without the presence of moisture, such showers occurring at intervals and after the lapse of short periods of time; or if the local conditions should require that such ashes have been driven by a steady wind into a dry crater-shaped hollow, where they have been received and

accumulated in layers, such a mode of accounting for the phænomena would best agree with the result of the author's investigations, and his knowledge of the materials of which the deposit is made up.

10. With regard to the very puzzling question, whence these infusoria and Phytolitharia came, he suggests, partly on account of their including forms not now met with in a living state, that they may possibly have formed layers of turf, or perhaps brown coal, which by some accident have come within the range of volcanic activity; and owing to their incombustible and almost infusible condition have been erupted as showers of ashes. Such layers of infusoria he has already shown to exist, forming and accompanying the fissile coal near Siegburg and Geistingen on the Rhine, although on the Upper Rhine none have yet been determined. The tuff and firestone appear to have had a similar volcanic origin, but to be the result of eruptions of mud in which the infusorial strata have not been repeated, owing to their toughness. The sandstone from Engers appears to have been erupted in the condition of fused lumps, which have afterwards been united into a mass by a cement of a very different kind.*

II.—*On a remarkable Tuff of Volcanic Ashes containing Infusoria, from the Island of Ascension.*

The author was indebted to Mr. Darwin for several highly interesting specimens for microscopic investigation, obtained during his journey; and amongst them was a singular white and soft volcanic tuff obtained from an extinct volcano in the island of Ascension. Before stating the result of his examination of this rock, the author quotes from Mr. Darwin's work the following account of the circumstances of its occurrence:—

"*Concretions in pumiceous tuff.*—The hill marked in the map 'Crater of an old volcano,' has no claims to this appellation which I could discover, except in being surmounted by a circular, very shallow, saucer-like summit, nearly half a mile in diameter. This hollow bas been nearly filled up with many successive sheets of ashes

* The author here appends a table, in which the occurrence of each species in each one of the thirty-nine different rocks of the Hochsimmer section is recorded. It will be found facing page 139 of the Proceedings of the Berlin Academy *(Berichte)* for 1845.

and scoriæ of different colours, and slightly consolidated. Each successive saucer-shaped layer crops out all round the margin, forming so many rings of various colours, and giving to the hill a fantastic appearance. The outer ring is broad and of a white colour, hence it resembles a course, round which horses have been exercised, and has received the name of the Devil's Riding-School, by which it is most generally known. These successive layers of ashes must have fallen over the whole surrounding country; but they have all been blown away except in this one hollow, in which probably moisture accumulated, either during an extraordinary year when rain fell, or during the storms often accompanying volcanic eruptions. One of the layers of a pinkish colour, and chiefly derived from small decomposed fragments of pumice, is remarkable from containing numerous concretions," &c. (Volcanic Islands, p. 47.)

This singular example of volcanic ashes met with in a true volcanic island, insolated and situated off the coast of Africa, exhibits however, on a careful microscopic investigation, none of the characters of an ordinary inorganic volcanic ash; but, on the contrary, the whole mass is of organic origin, scarcely changed in its separate parts, but entirely deprived of every form of carbon, which has probably been dissipated on the mass being exposed to a red heat. This completely rainless and treeless island, covered only with a scanty vegetation, on which no land birds are able to exist, as we are informed by Mr. Darwin in his 'Journal,' can hardly have had such a periodical supply of water in this so-called 'old volcano' as to have allowed many plants to grow, since our traveller does not mention the existence of their remains in that place.

When it is considered that thirty species of organic bodies, chiefly remains of plants (Phytolitharia), but including also siliceous-shelled infusoria, have been obtained from this most characteristic form of a tufaceous deposit in a circular band surrounding a supposed volcano, the phænomenon appears beyond a doubt very enigmatical, and requires to be considered in a somewhat new point of view in order that it may be solved.

The specimens of this tuff that were examined do not merely exhibit the organic forms distributed more or less abundantly through the mass, but they seem actually made up of them, since even the

dust-like powder or detritus mingled with them may be considered as merely fragments reduced to a very fine state of subdivision.

An examination of the specific forms determines the singular and very important fact, that the greater number of these are widely spread, reaching even to Europe, and that they are of land or fresh-water origin. Eleven of the number, besides these known species, must also be placed amongst the freshwater forms, and most of them are little siliceous particles from grasses, while there is not one single marine species to be met with amongst the whole number of organic bodies thus composing a rock in the middle of the ocean. It yet remains to be determined what the thickness of the bed is, and in what relation it stands to the other pumice in the neighbourhood; but these infusoria can hardly be considered as having relation to the present scanty vegetation of the island.

III.—*On a White Volcanic Rock or Tuff from Patagonia containing Marine Infusoria.*

The author states, that amongst many other objects for examination received by him from Mr. Darwin, one of them was a white tufaceous rock, described by Mr. Darwin in his 'Journal'* as characteristic of the tertiary formations of Patagonia, and covering a great deposit, including many tertiary shells, all apparently extinct. This bed (the tufaceous rock) has been incorrectly described as chalk, but it much more nearly resembles a deposited felspathic mass.

The specimen examined presented under the microscope the character of a crumbling pumice or tuff containing fragments of infusoria. When this result was communicated to Mr. Darwin, he requested the author to experiment upon the mass in a more special manner, and forwarded specimens from Port St. Julian, Port Desire and New Bay, accompanied by the following remarks received in a letter from him:—

"I have to thank you for your remarks on the white Patagonian rock, and to state that for many reasons I had arrived at the same conclusion as yourself, that it is originally a volcanic product. Unfortunately you do not mention which of the specimens of white

* 1st ed., p. 201; 2nd ed., p. 170.

stone contain infusoria, and I think I forwarded several, with their localities marked.* The formation is on a grand scale; it contains much gypsum, it has the consistence of our chalk, but is perhaps somewhat softer, and it has an enormous extension. At Port St. Julian it cannot be less than 800 feet thick. Its average breadth is at least 200 miles, and probably more, while it extends from north to south at least 550 miles."

The author on this renewed his investigations with every possible attention, and communicates the result, enumerating the species and their localities. The number of species described amounts to thirty; but he states that every fresh investigation has increased this number, and has also tended to confirm the volcanic character of the rock.†

These thirty organic bodies, associated with very minute fragments of cellular glassy pumice greatly resembling them, so completely make up the whole mass of this Patagonian rock, especially at New Bay, that either the shells or fragments of them can be detected in every little morsel not larger than a pin's head. It is also perfectly clear that they have been subjected to a high temperature, which has burst them asunder, bent, polished and altered them. It is even probable that the glassy crushed fragments are also derived immediately from these organic products; but there are here and there, besides these, green crystals resembling augite.

This mass chiefly consists of species which inhabit salt water, and of these many have been long known and are widely extended through the ocean; but several of them are new and peculiar, and resemble in shape small stars. Nearly half of them are the siliceous particles of marine sponges whose forms are known, and of which we are in some cases acquainted with the origin.

The Patagonian rock thus described is therefore manifestly a sea-bottom which has been subject to volcanic action.

* The author had found these remains in all the specimens.

† The species of Polygastrica (infusorial animalcules) amount to seventeen, and the Phytolitharia are thirteen. They are thus distributed :—

	Polygastrica.	Phytolitharia.	Total.
Port St. Julian	10	8	18
Port Desire	13	7	20
New Bay	2	1	3

In this case, as before, the spiculæ of sponges, which are always detached and fragmentary, can neither have penetrated the volcanic tuff, nor can they have been there developed in a fragmentary state, while such a notion is still less tenable with respect to the infusorial animalcules. A merely elevated sea-bottom which had not been exposed to intense heat must necessarily have exhibited various organic bodies, as in Oran, Sicily and Virginia, containing entire sponges, corals, foraminifera and shells, and would not merely consist of fragments of pumice and of siliceous-shelled infusoria. Foraminifera and all other calcareous remains are here entirely absent, and they, as well as the argillaceous particles on the sea-bottom, have probably served partly as a flux for reducing the fused siliceous particles, and have partly been decomposed to form the gypsum.

[The author then proceeds to describe several infusorial remains occurring in the loamy earth of Patagonia and the banks of the Plata, whence were obtained the gigantic mammalian remains of Edentates and other animals brought home by Mr. Darwin and described by Professor Owen. These are almost entirely of freshwater origin, and differ therefore from those found in the rock already alluded to. He next mentions two kinds of Phonolite, the trass of the Siebengebirge, and the ashes under which Pompeii is buried, as all containing infusorial remains, although the number of species is not considerable; and he concludes by alluding to a singular instance of a body apparently organic but not infusorial, found in the trachyte of Zimapan in Mexico. These matters not bearing directly upon the principal point in question in this memoir are here omitted.—Ed.]

Sketch of the general results of these investigations.

1. The recent, varied and careful researches have confirmed the notion that there exists on the Rhine, in districts marked by volcanic action, a very intimate and general relation between organic life in its most minute form and the results of volcanic activity. Crystals of volcanic origin, either pyroxene (augite), sodalite or leucite, are mixed up directly and intimately with the fused fragments of freshwater infusorial remains in rocks the thickness of which amounts to nearly 200 feet.

2. On the volcanic island of Ascension in the middle of the Atlantic, which is singularly barren of life, being entirely without trees and almost without water, there exists a considerable deposit

of volcanic ashes, which according to microscopic analysis is clearly shown to be made up exclusively of organic bodies, most of them the siliceous parts of plants, but some of them the remains of infusorial animalcules; and these are not species inhabiting the sea, but are, without exception, confined to freshwater.

3. According to the result of numerous observations made with reference to various localities in Europe, Asia, Africa and America, it appeared that the relation of microscopic organic bodies to volcanic rocks was strictly confined to those forms known only as existing in freshwater, and it seems also, as stated above, that this is the case in the island of Ascension, under very striking circumstances. This might have been supposed to arise from the similar marine forms not having been yet observed, or from the mixture of other material at the sea-bottom having rendered the whole more readily fusible, and so not presenting the phænomenon for investigation. There has now, however, been found a volcanic formation of infusorial tuff forming mountain masses in Patagonia, and exhibiting distinctly its marine origin, so that this remarkable appearance of an exclusively freshwater origin is taken away, and the marine forms are fully represented.

4. In Patagonia this *Pyrobiolite* rock is developed into a terrace-shaped formation upwards of 800 feet high, greatly resembling the European chalk, although without any trace of carbonate of lime, and containing here and there a considerable quantity of gypsum. It forms apparently one of the largest uniform masses of rock that we know of on the earth, amongst those manifestly due to the same agency throughout and perfectly continuous, and exhibits everywhere, and is perhaps chiefly derived from, the influence of the most minute forms of organic existence.

5. The Patagonian white tuff, formed perhaps during the submarine eruptions of the great Chilian and Patagonian Cordilleras of the south-western part of South America, and possibly the result of the great and uniform activity of the eruptive forces which elevated that chain of mountains, must be of tertiary or yet newer date since the pyrobiolite rock reposes on fossiliferous tertiary strata. It would not be unimportant to subject to careful microscopic inves-

tigation the fine dust which often falls during showers of volcanic ashes.

6. The ashes which buried Pompeii were of freshwater origin, and neither sea-water or a sea-bottom seem to have had anything to do with the volcanic eruption to which they were due. The formation, in all essential points, resembles that of Hochsimmer.

7. From an examination of its microscopic contents it has been made clear that the ossiferous beds on the Plata and at Monte Hermoso, as well as those near Bahia Blanca (both of which are in Patagonia), are unchanged deposits made in slightly brackish water —probably the result of some great irruption of the sea upon the low lands of the mainland.

8. It also appears that the original trachyte of Mexico, the matrix of the fire-opal, affords distinct indications rendering probable its relation to organic forms, and suggesting closer examination. It appears within the limits of possibility that all masses derived from trachyte may be in a similar condition.

9. The idea that the most minute and invisible living beings exercise a mighty influence on the solid igneous framework of the earth,—an idea which was at first only suggested, but is now confirmed by every fresh investigation,—renders it possible that a far greater extension may yet be looked for, and we may therefore be prepared to expect corresponding results on the grandest scale.

10. The recognition of organic influence in the case of so many of those rocks of which the earth's crust is made up, renders it very desirable that the limits of the extent of this influence should, as far as possible, be marked out. The names siliceous sinter (Kieselguhr), mountain meal (Bergmehl), tripoli, polishing slate, paper-coal or dysodil (Blätterkohle), limestone, semi-opal, hornstone, ironstone, &c., now require, not indeed mineralogically but geologically, that we should be able to distinguish them by some general name, so that there should be no danger of describing under the same appellation matter of very different kinds. This might no doubt be effected by speaking of 'organic or infusorial siliceous sinter,' 'infusorial tripoli,' and 'altered volcanic or unaltered volcanic freshwater or infusorial tripoli;' or we might speak of 'polythalamial limestone,' 'organic or

infusorial iron,' &c.; but all these long additions to ordinary expressions are manifestly inconvenient, and the same difficulty occurs with regard to the names 'tuff,' 'volcanic conglomerate,' 'pumice,' 'phonolite,' &c.

The author then suggests as a convenient nomenclature, that we should denominate those minerals which do not exhibit either among their actual component parts or from the conditions of their aggregation any marks of organic existence, 'elementary tripoli,' 'elementary limestone,' 'elementary pumice,' &c., or together, *Stœchiolite* (elementary rock), in contradistinction to the other group, which we may designate *Biolite* (organic rock).

True *Biolites,* however, are not those rocks and formations which simply contain fossils, but those which are deduced from and consist of agglomerations of organic bodies either absolutely or essentially, and which merely contain inorganic particles here and there distributed amongst them. By this name however we may correctly designate infusorial polishing slate, tripoli, the whole mass of polythalamial chalk, coal, &c. Fossil shells, corals and bones are sometimes indeed so far components of rocks as to form entire masses, but they are generally extraneous, although often characteristic contents.

On the other hand, the true well-defined elementary rocks *(Stœchiolites)* are those which have no essential and original relation with organic existence, and only occasionally and accidentally contain fossil organic bodies.

For those rocks of organic origin which have not been subsequently modified by volcanic agency it would be both convenient and definite to employ the more special name *Hydrobiolite,* while those, on the other hand, which have been so altered, we might call *Pyrobiolite,* or *pyrobiolitic rock, earth,* or *formation.* And if it should seem that a still further subdivision would be useful, we might describe such rocks as the paper-coal (dysodil), the Bilin polishing slate, mammillated slate, and other freshwater substances of this kind, *Hydrozoolite,* while coal, &c. might be called *Hydrophytolite.* So on the other hand we might designate white chalk and the Sicilian marly chalk, as well as the Virginian infusorial marl, *Halizoolite* (from its relation to marine organic life).

It is to be hoped that after this manner the relations of rocks to their organic and inorganic elements may find a more ready and general expression, and that investigations which are not to the purpose, and collision with existing theories so far as they relate merely to forms of expression may be avoided, and the principles involved be soon distinctly recognised.—*From Journal Coal Society.*

D. T. A.

Notice on the Coal-Fields of Alabama; being an extract from a Letter to the President from Charles Lyell, *Esq.*, F.R.S., *dated Tuscaloosa, Alabama,* 15*th February,* 1846.

Since my arrival in Alabama I have devoted part of my time to the investigation of the carboniferous rocks, and have obtained information respecting some coal-fields, the very existence of which in this state was unknown to me in 1844, when I compiled the map of the Geology of the United States, published in my 'Travels.' On my way southwards, I had learnt from several persons in Georgia that the city of Mobile was supplied with bituminous coal, brought down from the Tombecbee River from Tuscaloosa, a navigation of about 400 miles. This coal is procured from the neighbourhood of Tuscaloosa, a place situated near the centre of Alabama, and more than a hundred miles further south in a direct line than the southern limit which I had assigned to the Appalachian coal-field, which I supposed to terminate near the great bend of the Tennessee River.

The fact of coal occurring near Tuscaloosa had been previously mentioned to me by Mr. Conrad, but he was uncertain respecting its age; and the circumstance of its occurrence near the Falls of the river, not far from the northern outcrop of the cretaceous strata, together with the fact of its quality being preferred to all other coal for the manufacture of gas at Mobile, made me suspect that it might prove to be of the age of the Richmond coal, which is also bituminous, situated near the Falls of the James River, and which, as Professor W. B. Rogers has pointed out, is newer than the ancient carboniferous series.

In order to determine on the spot the question in regard to its age, I ascended the Tombecbee from Mobile to Tuscaloosa, where at the University I found Professor Brumby, who had examined with considerable care the geographical boundaries of the productive coal-measures and the structure of the region. With him I made an excursion to some of the pits, or rather open quarries of coal, where the edges of the beds of several seams have been dug into by different individuals entirely ignorant of mining operations, but with no small success, the quality being good at the point of the natural outcrop. I found the coal-seams covered everywhere with beds of ordinary black carbonaceous slate full of impressions of more than one species of calamite, with ferns of the genera *Sphenopteris* and *Neuropteris*, and impressions of *Sigillarea* and *Lepidodendron*. In some of the beds *Stigmaria* has also been met with not unfrequently, and I recognise a specific identity between several of the most common of these coal plants, and those which I formerly obtained from the mines of Ohio and Nova Scotia. I also observed the complete difference between these fossil plants and those most characteristic of the newer or Virginian coal-field near Richmond, which I lately had an opportunity of examining on my way south. The strike of the coal-beds in Alabama is also, where I have seen them, north-east and south-west, agreeing with the general direction of the Allegany Mountains, of which, geologically speaking, they are evidently a southern prolongation. They are, in fact, portions of the great Appalachian coal-field, with all the same mineral and palæontological characters, the beds having been bent into similar ridges to those of the Alleganies, with corresponding dips to the north-west and south-east; and we have no reason to suppose that Tuscaloosa, in lat. 33° 10′ south, is the extreme southern limit of the formation, for the carboniferous strata are merely concealed from observation south of this point by the lower gravelly and sandy beds of the cretaceous group which extends to Tuscaloosa.

In the eastern part of Alabama, a zone of hypogene or granitic rocks separates the tertiary and cretaceous strata of the Atlantic plain from the older formations of the Allegany Mountains, as is usual along the eastern borders of the United States. This granitic formation still appears at Wetumka on the Alabama River, where

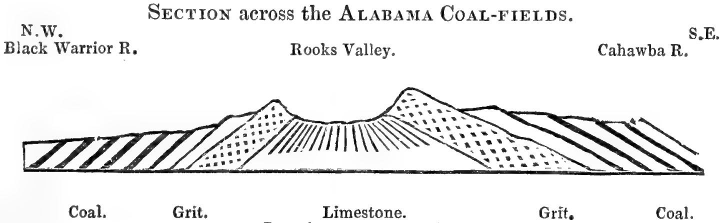
the lower cretaceous rocks, as I learn from Professor Brumby, rest on mica schist; but on reaching the Cahawba further west, and the Warrior River at Tuscaloosa, we find the carboniferous strata concealing the granite, and coming, as before stated, into direct contact with the cretaceous rocks, which I have seen resting unconformably upon the coal at the Falls at Tuscaloosa. At this junction the cretaceous group consists of beds of quartzose gravel, such as I have seen intimately connected with cretaceous fossils at Montgomery on the Alabama River. At Tuscaloosa the underlying grey, micaceous sandstone of the coal is full of calamites and impressions of lepidodendron and sigillaria which I beheld with no small interest, as they constitute, if I mistake not, the extreme southern limit to which the peculiar vegetation of the ancient carboniferous æra has yet been traced, whether on the western or eastern side of the Atlantic. It is due to Mr. Conrad to state, that in an outline map of the Geology of Alabama made during his tour in 1833, and which he presented to me in 1842, with permission to publish any part of it, I find the northern boundary of the lower cretaceous deposits in their course through the States marked out with considerable approach to accuracy.

The several members of the carboniferous series which I have seen while in company with Professor Brumby, within a distance of between thirty and forty miles north-east of Tuscaloosa, consist, first, of productive coal-measures, containing the usual white quartzose, sandstones and grits, with greenish and yellowish sandstones, some of which are thinly laminated and ripple-marked, and contain calamites. These form the highest beds, and below them shales and clays predominate with several subordinate seams of coal, from three to upwards of four feet thick. Below these beds, of which I saw a thickness of many hundred feet, there lies, secondly, a great deposit of quartzose grit, of which millstones are sometimes made, and which reminded me of our millstone-grit, and of the fundamental conglomerate of the Appalachian coal-field. It passes downwards into thinly laminated sandstones and dark slates of small thickness. This group is succeeded (3) by fetid limestones, with chert and hornstone, usually without fossils, but in some of the siliceous beds of which, casts of Encrinites, Producta, Orthis, and several corals abound. This inferior formation, which may perhaps belong entirely

to the carboniferous series, also contains still lower down a limestone charged with iron; and an enormous mass of brown hematite appears to constitute a regular bed, and not a vein, and to be destined one day, like the coal, to be a source of great mineral wealth to Alabama.

It would have been impossible for me, during my short visit, to form more than a conjectural opinion respecting the structure of this coal-field, still less to determine its geographical area, had not these subjects been previously studied with great care and scientific ability by Mr. Brumby. Of the extent of the coal in Alabama he published a brief account in 1838 in Barnard's Almanac, and communicated the same to Dr. Silliman; and from the observations which we have lately made together, and from his notes and information, it may be inferred that a section from the north-west to the south-east, passing through the basins of the Warrior and Cahawba Rivers, would present an anticlinal axis along the line of the water-shed between the two rivers, in the middle of which the beds are highly inclined and often vertical, while on both sides the productive coal-measures occur in separate basins, the strata having a slight dip, and being in many places nearly horizontal. These views will best be explained by the annexed section.

SECTION across the ALABAMA COAL-FIELDS.



Length of section 50 miles.

In regard to the most western of the two coal-fields, or that on the Warrior River (the principal tributary of the Tombecbee), it has been found by Professor Brumby to be no less then ninety miles long from north-east to south-west, with a breadth of from ten to thirty miles, extending through the counties of Tuscaloosa, Walker, Jefferson and Blount, on both sides of the Warrior River several branches. Throughout all this area, seams of bituminous coal crop out; but the number and thickness of these it has

as yet been impossible to ascertain, no survey having been made. They must however be numerous, for I saw several separated by a slight thickness of intervening strata at points between eleven and twenty miles north-east of Tuscaloosa; and I am informed, that in one place in the bed and banks of the Warrior River three seams are exposed to view, one above the other, the lowest and largest being ten feet in thickness.

The more eastern coal-field, or that of the Cahawba, is nearly of equal length and breadth, terminating southwards at Centreville, where it meets the lower cretaceous beds, and extending from thence through Bibb, Shelby, Jefferson and St. Clair counties, to the source of the Cahawba River. In this also numerous beds of coal of good quality have been found, and worked to slight depths.

A third coal-field on the northern confines of the State of Alabama, is that of the Tennessee Valley. It is separated from the two former by a broad but low chain of mountains, running nearly east and west, which intervenes between the Tennessee and the sources of the Warrior and Cahawba rivers. These mountains, according to Professor Brumby, consist of strata older than the productive coal-measures, and similar to those seen by me in Rook's Valley.

The coal on the Tennessee, above alluded to, may perhaps be continuous with that of the great Appalachian coal-field. I hope hereafter to be enabled to give a more full account of the fossil plants of these Alabama coal-fields, a comparison of which, since they form the extreme southern limit of the carboniferous flora, with those of the north, will deserve particular attention.

London, June 23, 1846.—The above observations were written at Tuscaloosa in February last, and sent from thence to the Geological Society. On my return to England I found the paper already in type, and about to be printed off, but an opportunity having been offered me of adding this note, I submitted the specimens to my friend Mr. Charles J. F. Bunbury, F.G.S., who immediately compared them with published plates and the fossil plants in the Society's collection. The result of his examination confirms the conclusions to which I had arrived, and his specific identification of several of the Alabama remains with well-known European fossils is highly

interesting. Although the decomposed state of the matrix in which the plants were obtained, near the outcrop of the strata where the shales are changed into soft, pale, laminated clays, has occasioned the loss of some of the Ferns and Sigillariæ, Mr. Bunbury has nevertheless been able to give a list and description of the following sixteen forms :—1. *Sphenopteris latifolia,* Ad. Brongn. 2. *S. Dubuissoni?* Ad. Brongn. 3. *Sphenopteris,* allied to the last, perhaps a variety of the same. 4. *Neuropteris tenuifolia,* Ad. Brongn. 5. *Neuropteris grangeri,* or *N. gigantea?* 6. *Calamites cannæformis.* 7. *Calamite,* obscure specimen allied to the foregoing. 8. *Lepidodendron elegans,* var.? 9. *Lepidodendron,* allied to *L. dilatatum,* Foss. Flora. 10. *Lepidophyllum?* 11. *Sigillaria,* decorticated. 12. *Stigmaria ficoides.* 13. *Poacites?* 14. *Bechera tenuis,* n. sp., very nearly allied to *B. grandis,* Foss. Flora. 15. *Asterophyllites? flaccida.* 16. *Phyllites,* resembling the leaf of *Sparganium.*

The palæontologist will perceive at once that no less than half of the species in the above list agree with well-known European fossils of the old carboniferous formation, and the rest belong to genera which are common in our coal-measures, and may perhaps agree with European fossils when procured in a better state of preservation. The leaves resembling Sparganium, however, which are very abundant, appear to Mr. Bunbury to be new.

When we recollect that the Tuscaloosa coal is found in lat. 33° 10′ north, and that several of its most common fossils are of the same species as those of Northumberland in lat. 54° north, at a distance of nearly 5,000 miles (the broad Atlantic Ocean now intervening,) we cannot but be struck with this new proof of the wide extension of a uniform flora in the Carboniferous period, especially as Alabama is situated much farther south than any region in which this ancient flora had previously been studied, whether in Europe or North America. Geologists will therefore rejoice to learn that Professor Brumby is fully alive to the importance of a more full investigation of the plants of the country, of which he will soon, it is hoped, have it in his power to form a large collection.—*From the Quarterly Journal Geological Society.* C. L.

Habitation and Destruction of the Mammoths. By Sir R. I. Murchison, F.R.S., &c.

Habitation of Mammoths and their Destruction—Similar Mammoth Burial in Western Europe—Siberian Entombment of Mammoths—British Anologies—Conditions of Mammoth Burial explained—Views of Lyell, Humboldt, and Owen—Ancient Geography of Siberia—Remote Age of the N. Courses of the Great Siberian Streams—Elevation of Siberia, and End of Mammoth Period—Fossil Quadrupeds of European Russia—Mammoth Clay Drift at Taganrog—Whether Extinct Bos Urus and Living Aurochs are the same?—If so, its Preservation explained—Subject of Great Fossil Mammalia concluded.

Though mammoths occur in certain quantities on the flanks of the Ural, thus leading us to believe, that when alive they inhabited the tract where their skeletons are entombed, it must be recollected, that as, by other proofs, we have already endeavoured to shew the comparatively recent elevation of the Ural crest, this region cannot be looked upon as having been rendered highly mountainous, until the very period when great numbers of these animals were destroyed,—a destruction which we believe to have been mainly accomplished when the present watersheds between Europe and Asia were determined. Let us suppose, then, that the mammoths and their associates ranged over these hills when they formed the elevated edge of an eastern continent. Further, let it be assumed (and this, indeed, is quite in accordance with the physical features of this region), that the greater number of the broad depressions which are now filled with auriferous and mammoth detritus, were *then occupied by lakes,* in the grounds around which these extinct quadrupeds had long lived, and into whose shores or bottoms *their bones had been washed for ages,* and we shall then have before us the conditions which will best explain the Uralian phenomenon. No one can observe what the Russian miner has accomplished, by damming up the existing rivers, and thus forming artificial lakes in every sinuous tract in which ores are worked, without being naturally led to the idea which we suggest, that larger and deeper lakes were formerly in existence,—lakes, in fact, which in still more primeval times fed the great rivers that washed the Permian detritus to the sea then existing upon the west.

Granting these premises, all the relations of the Uralian mammoth alluvia may, it appears to us, be rationally explained; for in some of the most violent movements of elevation which gave rise to the present central watershed, we may readily conceive how, their barriers being broken down, these lacustrine waters were poured off, and how their shingly bottoms and shores, already containing bones of mammoths, were desiccated and raised up into the irregular mounds which now constitute the auriferous alluvia. The very nature of the auriferous shingle, with its subangular fragments, so completely resembles the detritus of lakes, and it is so unlike the gravel formed on the shore of seas, that independent of the *entire absence of any marine remains whatever of tertiary or recent age*, all along the immediate eastern flank of the Ural mountains, we have no hesitation in believing, that the gold detritus was accumulated during a terrestrial and lacustrine condition of the surface. One fact only which we have mentioned seems, at first sight, to militate against this view, viz., the deeply eroded surfaces of some of the palæozoic rocks. But however these appearances may have been produced, it is manifest they could not have resulted from the denuding action of the same water in which the shingly and slightly rounded angular detritus was formed. Such abraded surfaces may, to a great extent, have been produced, at periods long anterior to that of which we are now treating, and when the edges of the palæozoic strata, first emerging from beneath the sea, left their irregular and water-worn surfaces to be filled with terrestrial and lacustrine deposits of after days.

In some cases, however, the denuding and abrading power of waters, produced both by the bursting of lakes and the change in the direction of the currents, must have been very considerable, for such alone would account for several of the appearances we have spoken of, and the transport of large blocks and enormous pepites of gold into broad lateral depressions.

In proposing a lacustrine entombment for the Uralian mammals, we are borne out by the constant position of thick masses of silt and clay overlying the coarser shingle. If the deposits had been submarine—even if no traces of shells were visible, there might have been some indications of the action of the waters—some appearance of a coast line; but nowhere can the geologist imagine such a former

state, whilst the superposition of the clay to the shingle is best explained on the hypothesis of formation, under lacustrine or broad fluviatile conditions, which eventually assumed a tranquil character. Such, in fact, are precisely the cases of the great valleys of the Rhine and the Danube; and just as we have imagined that the mammoth lived in those Uralian tracts, when the adjacent parts of Siberia were occupied by lakes, so do we suppose that the like animals, whose bones are found, both in the coarse shingle of the Rhine, and in the overlying löss near Baden-Baden, once lived upon the grounds which now constitute the Black Forest, and adjacent alpine tracts, whence the detritus has been derived. With evidences of internal lakes and ancient rivers, in which the bones of some of its ancient quadrupeds were lodged, Great Britain, though evidently also the abode of mammoths, is distinguished from the Ural and Siberia, in exhibiting around its coasts, and even far into the interior, the proofs of the abode of the sea or marine estuaries during long periods.

But we now return to the Ural. A former terrestrial surface on which the great quadrupeds lived for long ages, and the rupture and desiccation of adjacent lakes, coincident with some of the last elevations of the chain, will, we are convinced, best explain the condition in which the remains of the mammoths are left buried on the edges of the uplifted ridges of the Ural, as well as in the low lands and great estuaries farthest removed from them. In the depressions at the very foot of the chain, the mammoth skeletons are broken up, and their bones, together with those of *Rhinoceros tichorhinus* and *Bos Urus*, are rudely commingled in the coarse shingle derived from the mountains, or in the clay above it. In proportion, however, as we advance into the plains of Siberia, or descend into the valley of the Tobol and the Obe, or their affluents, these bones increase in quantity, and are at the same time in much better conservation. Even in the flat country of Siberia, about thirty versts eastward of our excursion on the Issetz (see p. 366), Pallas mentions the occurrence of teeth, vertebræ, and bones of mammoth, and remains of fossil ox, as having been found abundantly by the peasants at several localities near Tamakulsk, and the source and banks of the little streams Atish Suvarish, both tributaries of the Issetz. He also gives (from the information he received) a detailed account of the

order in which various beds of sand and clay there succeed to each other, and in which sharks' teeth and palates of fishes also occur. Hence he concludes that the beds in which the bones were found formed the bottom of an argillaceous sea; and that certain sandy, micaceous materials, in superior beds, were washed down from the mountains. Now, we cannot for a moment suppose that the great naturalist could have been mistaken in the marine character of the fish remains; but, as he did not visit the spot himself,* there may still be some doubt that the mammoths' bones occur in the very same beds with the fossil wood, sharks' teeth, &c.; for these, we apprehend, must certainly belong to the tertiary deposits of clay, sand, lignite, and millstone grit, of which we took leave at Kaltchedansk, and which appear to extend widely into Siberia. That deposit is, we must think, of higher antiquity than the detrital accumulations which enclose the mammoths. However this may be, the further the Siberian rivers are followed towards their mouths, the more, we repeat, do the mammalian remains increase,† until at length whole skeletons have been found entire, some with all the flesh and hair adherent. Unwilling, as we always were, to adopt the idea of Cuvier, and other eminent geologists, that entire mammoths, with their skin, were killed and preserved by a sudden change of climate, we now distinctly advocate the views of Lyell and Humboldt, that these creatures were the denizens of countries near to which their bones are found.‡

* Pallas derived his information respecting the order of the beds and the position of the remains at and near Tamakulsk, from Colonel Bibikoff, Director of the Forge Kamensk. (See vol. ii., p. 392, French Edition, 1793.)

† Sujeff, the associate of Pallas, found these mammalian remains in great abundance on the banks of the Obe, near the mouth of the Pittiarski, and 150 versts south of Berezof. (Pallas, vol. iv., p. 50.)

‡ For some time, the frozen mammoth found by Adams, and deposited in the Imperial Museum at St. Petersburg, was an unique specimen. Since then, two other examples have been reported, and one of these is, we are informed by Mr. Frears, on the point of arriving at the Museum of Moscow. The conservation of the skin is, indeed, not peculiar to the mammoth, but also applies to the *Rhinoceros tichorhinus*, portions of whose skin and hair are still adherent to the bones of a fine specimen of that animal, preserved in

The single fact of the very wide diffusion of mammoth bones over the surface of such enormous regions of the earth, would in itself lead us to believe, that those creatures had really been long inhabitants of such countries, living and dying there for ages, whilst their final destruction may have resulted from aqueous debacles dependent on oscillations of the land, the elevation of ridges, and the formation of much local detritus. In the case of the extinct species of carnivora, it has been happily and successfully shewn by Dr. Buckland, that for long ages they inhabited the caves of the British Islands. Again, in low tracts of Yorkshire, where tranquil lacustrine deposits have occurred, there bones (even those of the lion) have been found so perfectly unbroken and unworn in the fine gravel in which they are heaped up (as at Market Weighton),* that few persons would be disposed to deny, that such feline, and other animals, once roamed over the British Isles, as well as other European countries. Why, then, is it improbable, that large elephants, with a peculiarly thick integument, a close coating of wool, and much long shaggy hair, should have also been the occupants of wide tracts of Northern Europe and Asia?† At one time, it was deemed expedient to

the Museum of Natural History at St. Petersburg, and deposited there by Pallas. On referring personally to Baron Humboldt, since the publication of his work on Central Asia, he expressed his opinion, that the perfect conservation of the skin, mustachios, and whole body of Prince Menzikoff, buried 100 years ago in Siberia, and accidentally disinterred, ought to satisfy us respecting the conservation of the mammoth, by simple reference to the climate of that country.

* The researches of the Rev. W. V. Harcourt, and of Mr. H. E. Strickland, are most important in shewing (the former at Market Weighton, the latter at Cropthorne on the Avon) the co-existence of the mammoth, *Bos Urus*, rhinoceros, hippopotamus, lion, bear, tiger, hyæna, deer, &c. (all of species distinct from those in existence), with land and freshwater shells, nearly all of which are identical with species now living in Britain; thus proving, that no very great change of climate has taken place since these animals were contemporaneous. (See Proceedings of the Geological Society, 1834, Silurian System, p. 554, and Phil. Mag., September 1829 and January 1830.)

† This coating, Dr. Fleming has well remarked, was probably as impenetrable to rain and cold as that of the musk ox of the Polar Circle. Edin. New Phil. Journal, No. 12, p. 285.

imagine a sudden fall of temperature, in order to account for the peculiar conservation of these creatures, by which they were supposed to have been at once frozen up in the mud into which they had been washed, or the morasses into which they had sunk.

The discovery, indeed, of a *Rhinoceros tichorhinus* by Pallas, with its skin and flesh adherent, upon the banks of the Vilgni, a tributary of the Lena (a portion of this rhinoceros, with the skin and hair adherent to the sides of the head, are now to be seen in the Museum of Natural History at St. Petersburg), and still more, the subsequent acquisition of the entire carcase of a mammoth, on the banks of the Lena, in lat. 70° N., by Mr. Adams, the details relating to which have been so fully given by geologists of all countries, naturally, indeed, led to such ideas. Convinced by their perfect preservation, that these animals must have lived in or near the countries where their bones are found, Cuvier declared it to be his opinion, that they must have disappeared by a revolution, which at once destroyed all the individuals, accompanied by a sudden change of climate.

In England, this view was very ably sustained by Dr. Buckland, and particularly in his memoir on the fossil remains which occur in Eschscholtz Bay, and other places on the east side of Behring's Straits,* where vast quantities of mammoths' bones occur in mud cliffs, apparently similar to those of the mouths of the Lena, and other great rivers in Northern Siberia. So long as geologists were compelled to argue upon the nature and habits of the mammoth, as if it were similar to an Asiatic elephant, the opinions of such great masters were necessarily dominant. Mr. Lyell had, however, the courage to lead the way in taking a new and highly philosophic view of the subject, by suggesting, that the peculiar covering of these great mammals rendered them fit inhabitants of a northern climate, and that no greater catastrophes were required to account for their destruction, than the gradual elevation of large masses of Siberia, which, laying dry the low

* *See* Beechy's Voyage to the Pacific, vol. ii., Appendix, p. 593. Besides the abundant remains of mammoths, Dr. Buckland describes those of *Bos Urus*, deer and horse. They occur in cliffs of mud and sand, about 90 feet high, which are usually much congealed and frozen.

shores and estuaries into which their bones had been washed, would necessarily render the climate much more intensely cold.*

But, even if it be admitted that the climate must have been more mild when mammoths lived than at the present day, there still occurred the obvious difficulty, that without some entire change in the nature of its vegetation, of which the surface of Siberia offers no indications, by no possibility could a great phyllophagous, or branch-eating animal, like the true elephants (which require rich Asiatic jungles for their sustenance), have lived in a region of fir-trees, birch, willows, and moss. Comparative anatomy and physiology have here, however, fortunately come to the assistance of the geologist; and in this, as in many other of his darkest paths, have been his surest beacons. Examining and comparing the composite structure of the very numerous teeth of the mammoth, Professor Owen has ascertained that they possess a peculiarity in the greater portion of the dense enamel which essentially distinguishes them from the teeth of the Asiatic or African elephant, and which specially provided the mammoth with the means of subsisting upon the coarser ligneous tissues of trees and shrubs. In short, this great zoological authority, combining the consideration of the peculiar structure of their teeth with the nature of their epidermis and coverings, has come to the conclusion that the mammoth was, by its very organization, a meet companion for the reindeer and other inhabitants of the north.†

Applying the views of Humboldt, we might well admit, that the rise of the Ural and Altai mountains, and with them, of enormous masses of the continent of Asia, must have so refrigerated Siberia, that its forests, which, in the halcyon days of mammoths, may have

* There is no portion of Mr. Lyell's speculations upon ancient physical geography which has impressed us with greater respect for his talents, than his view of the adaptation of the mammoths to a residence in the former Siberia; and we rejoice that the geological evidences we have brought to bear upon the question essentially sustain his inference. *See* Lyell's Principles of Geology, 4to ed., vol. i., pp. 141, 150, *et seq.*, where the whole question is discussed with reference to Dr. Fleming, and other zoologists.

† See Owen's History of British Fossil Mammalia and Birds, 1844, p. 261, *et. seq.*

extended in certain promontories to near the Icy Sea, had necessarily shrunk back to their present limits, and left these coasts entirely to the reindeer and its mosses. But to require our belief that the mammoth ever *lived* in the *northernmost* tracts of Siberia is uncalled for, since geologists well know that the wide and low tracts of northern Siberia, in which its remains are most abundant, were then evidently beneath the sea; and the bones must have been drifted thither, and possibly for some distance.* Yet if we suppose that these animals lived on certain lands, as in Ural and the north trending chains, up to 60° and 65° N. lat. (which facts and physical conditions warrant), we are still indebted to Professor Owen for having removed the greatest of all the difficulties which previously environed the problem; since there is no longer any objection to the mammoth being an inhabitant even of the Arctic circle, provided (and there are still such examples in Europe), fir-trees and shrub-like vegetables could exist in such latitudes.

From the physical structure of the region, we are, indeed, entitled to suppose, that not only the Ural and Altai mountains, but also their advanced northern ridges and plateaux (a half or two-thirds of Siberia), formerly constituted a region covered with forests, like those of the Ural, in some parts, and with brushwood steppes in others, from which whole herds of mammoths, as suggested by Mr. Lyell, would naturally migrate in the summers (even now intensely hot) to the embouchures of the great streams and edges of the then Arctic sea. Such might have been, we may add, the position and condition of some of these creatures at the periods when, as we have imagined, the highest ridges of the Ural were thrown up, followed by the rupture of many lakes, and the consequent inundation of large tracts of the flat country, previously frequented by these great herbivorous animals. During their long occupancy of these lands, myriads of their carcases must, doubtless, have been washed down by the rivers, and buried in local mud and alluvium—in such positions, in fact, as they are found along the banks of the Sosva add the tributaries of the Obe, before alluded to. Others, reaching the mouths

* Marine remains were found by Pallas, associated with mammoths' bones, in numerous places, and about 70° N. lat.

of the streams, may easily have been transported into the estuaries, and even, by the power of such volumes of water as are poured forth into the glacial ocean by the Obe, the Yenisei, and the Lena, borne out far to sea, and there lodged in former mud banks, which now constitute the shores of New Siberia, where thousands of bones of these mammals are interred.* If the power of drifting the bodies of animals to great distances be assigned to any rivers (and mariners have seen floating carcases in the ocean very far removed from the lands from whence they came), in no part of the world is it more probable that such operations may have been carried on upon a gigantic scale, than from the northern shores of Siberia, where such enormous rivers must have continuously extended their influence to several degrees of latitude beyond their mouths, and where the nature of the climate is singularly favourable to the conservation of animal substances.

And here let us say a word more on the ancient physical geography of this region. Such as are the present north-flowing courses of the great Siberian rivers, such, we affirm, they must have been from the very earliest periods—from the time, in short, when the palæozoic rocks constituting the Altai and Ural mountains, and their dependencies, were raised into dry lands, never more to be depressed beneath the waters of the ocean. Infinitely the loftiest and the grandest of these chains, the Altai, with its snowy peaks (yet void of glaciers), ranging from west to east, is the great southern watershed from whence the Siberian rivers must, we say, have flowed from south to north during long ages, whilst the peculiarity of all the great counter-forts or advanced ridges of that mighty chain, consists in their being composed of palæozoic, metamorphic, and igneous rocks, which equally extend from south to north in a number of long, low, meridian, parallel ridges. These north and south ridges, of which the Ural is the westernmost, thus encase each river, and, preventing its flexure to the east and west, have neces-

* See admiral Wrangel's Voyage for a description of the sands and mud of the "Tundra" (evidently all ancient marine sediment), in which the mammoth bones are found on the continent, including his companion, Anjou's, account of their enormous quantity in the isles of New Siberia. (English edition, translated by Mrs. Sabine.)

sarily determined its course to the glacial ocean, from epochs long anterior to the creation of a mammoth.

Looking to their low altitude above the sea, their muddy and sandy composition, and also to the discovery by Pallas of *marine remains* in many of them, we must believe that all the low promontories between the Obe, the Yenisei,* and the Lena, which lie northwards of the ancient ridges and plateaux, were under the waters and estuaries at the periods when the mammoths ranged over the Ural, the Altai, and the adjacent regions of Siberia, then above the sea.† Such of these creatures as were entombed in masses of tenacious clay at the mouth of these estuaries, would necessarily be preserved almost intact, whilst the desiccation and elevation of such mud banks, accompanied by an increase of cold, due to the raising up of a large terrestrial surface like Siberia, would thoroughly well account for the occasional conservation of their thick hides, and much of their animal matter.

Whether, then, we argue from the evidences presented to us in the Ural chain and its flanks, from the ancient geography of Siberia, or from the natural history of the mammoths, and their adaptation to existence in the same parallels of latitude as those in and near which they are now found, we can, it appears to us, arrive at no other

* We write Yenisei, like all other Russian words, as it is pronounced. The German J, as used by Pallas and the early German explorers of distant parts of Russia, has, unluckily, found its way into all English maps. Pallas states, that the fossil bones which fall from the high cliffs of the Yenisei, opposite Krasnoyarsk, are so numerous, that, on decomposing, they form a substance which he calls "Osteocolle." (Vol. iv., p. 443. Fr. Ed. See also Appendix to Beeche's Voyage.)

† The definition of the outlines of the land and sea during the mammoth period, or the extent to which marine estuaries entered into the continent of Siberia, including possibly even a separation of the Ural from the Altai, can alone be determined by the united labours of many observers. If the data of Pallas respecting the grounds on the lower region of the Issetz river, which is covered with black earth, may not also have been under an arm of the sea at that period. At the same time, we think that the granitic hills between Miask and Troitsk and the chain of Kara-Edir-tau, both of which are destitute of any traces of marine sediment, must have then been above the waters.

conclusions than those which we have endeavoured to sustain; and which, in fact, do not imply, even as great an oscillation of land within this comparatively modern period, as would be required to explain the surface phenomena of most other parts of Europe with which we are acquainted. In truth, the uprising of Siberia "*en masse*" to the height of one or two hundred feet above its general level, when mammoths lived, will amply suffice to explain both the desiccation of its northern shores into the mud of which the fossil terrestrial remains had been washed, and the increased cold over that vast mass of continental land.

In the mean time, we may repeat, that whether discovered in the gravelly detritus or clay on either flank of the Ural, in the high banks of the great streams which respectively flow into Asia and Europe, or in still greater quantities on the sides of the estuaries of the great Siberian rivers upon the glacial ocean; in all cases, we find the mammoths entombed in materials, which, whether coarse lacustrine shingle near the mountains, or mud and sand at a distance from them, all announce, in the most emphatic manner, that these great creatures lived in lands adjacent to lakes and estuaries, in which, during long ages their bones were interred, and were sometimes carried out to sea, and commingled with oceanic remains.

Though we now take leave of the Ural chain, we will terminate the subject which occupies us, by giving a brief abstract sketch of the manner in which the great extinct mammals are distributed over European Russia.

Fossil Quadrupeds of Russia in Europe.—Far from being peculiar to the Ural mountains and Siberia, the remains of mammoths, and other lost quadrupeds, have been found over very considerable regions of Russia in Europe. Pallas had long ago mentioned several localities where such mammalian remains have been observed. Though we ourselves are acquainted with situations in which they have been found, in the governments of Moscow, Vladimir, Perm, &c.; we best know them through the collections formed in the Imperial Museum of Natural History of Moscow, where, under the auspices and direction of our venerable friend Dr. Fischer, they have obtained a just celebrity.

In Russia, as in every other great region which has been examined, the races of lost mammals present some types which connect her former lands with those of other countries, associated with forms which are peculiar to her. Thus, whilst, in common with America, Russia contains the *Mammoth* and *Mastodon ;* and in common with Britain, the *Elephas primigenius, Rhinoceros tichorhinus, Trogontherium,* beaver, bear, elk, &c., she once possessed generic forms, as *Merycotherium* and *Elasmotherium,* which have hitherto been found elsewhere. Russia is, indeed, as peculiar in her possessions of the latter extraordinary pachyderm as South America is for the *Mylodon* and *Glyptodon.**

The lost races of mammals which have been detected in Russia in Europe are found, we have said, in exactly the same sort of detritus as that in which they occur in the flat northern tracts of Siberia, or near the mouths of its great rivers. In all the central and southern parts of European Russia, there are no high ridges of elevation, and, consequently, no coarse local detritus, like that on the flanks of the Ural, so that the mammoth alluvium assumes the same aspect as in the distant plains of Siberia, where it is equally removed from disturbing causes. Here, however, it is equally evident, that such alluvium has been the result of currents of water, for it is piled up, and often tumultuously, in great thicknesses, and constitutes the chief banks of most of the streams, as well as the covering of numerous plateaux. Occasionally, indeed, the coarser clay drift passes upwards into finely levigated silt, which, in certain tracts, may be represented by the rich black earth or tchornozem, of which we shall treat at some length in the last chapter. In illustrating the ordinary charac-

* The geological position of *Lophiodon Sibericum,* which is stated to have been found in a *calcareous formation* in the government of Orenburg, is doubtful ; if it be miocene, or eocene, it accords with the beds containing *Lophiodon* in Continental Europe and England. *Elasmotherium* may be said to be as peculiar to Russia as *Mylodon, &c.* to South America ; but we are informed by Professor Owen, that there are no existing analogues in Siberia to illustrate the *Elasmotherium,* like the sloths and armadillos of South America, which explain the affinities of the Megatherian animals. See Professor Owen's most remarkable work on the *Mylodon.* (4to, London, 1842.)

ter of the mammoth alluvia of European Russia, we cannot, perhaps, do better than cite the example of Taganrog, because, exceedingly remote from the regions we have been considering, and indeed, from any mountains, it there forms the summit of abrupt cliffs on the Sea of Azof, its relations to the underlying strata being well exposed. This mammoth drift is just as completely separated from any deposit resulting from existing agency, as the auriferous detritus and coarse clay on the sides of the Ural hills, or as the high mud-banks forming the cliffs of the great Siberian rivers and estuaries, for it covers the whole of the coast plateaux, the present adjacent river Krinka, and the Sea of Azof, being 100 feet beneath it. In truth, like similar drift over wide spaces of Central and Southern Russia, it is distributed at various levels, and most clearly indicates considerable submergence at the period when these animals were destroyed. Such facts as to the nature and distribution of the entombing materials which occupy cliffs high above the low valleys, compel us to believe, that the greater part of this low continent, *unlike* the Ural and the higher portions of Siberia, was not dry land during the existence of the mammoths, or in the period immediately antecedent to our own; but was then rather in the same subaqueous condition as the low lands of northern Siberia, when the mammoths' bones were there transported into estuaries. Hence, we think, that many of the mammalian remains to which we now allude, may have been transported into adjacent lakes and estuaries by rivers; and, in some instances, carried out great distances to sea from the surrounding lands; the Ural (including a large tract of Permia) and Siberia on the east, the Crimæa* and Caucasus on the south, or the Carpathian mountains on the west.

* See Demidoff, *Voyage dans la Russie Méridionale*, vol. ii. The reader will there find an account of the remains of bones of mammoth, bos, *Ursus spelæus*, horse, &c., as interred in a reddish coloured argillaceous drift near Odessa *(Terrain Clysmien)*, which covers the surface, and enters into the clefts of the subjacent tertiary or steppe limestone. M. Huot, the author of that description, refers this deposit to lacustrine waters. He also found the *Mastodon angustidens* associated with the mammoth at Kamisch Burun, near Kertch. These animals lived, of course, in the adjacent high grounds of the Caucasus and Crimæa (see our remarks thereon, p. 304).

But, besides these former encompassing lands, there are certain tracts within Russia, which, though now of no great altitude, are so exempt from debris and drift, that it is natural to infer they may have formed low islets in the ancient waters which covered the great mass of the present lands. This view we would support by an illustration drawn from natural history and the nature of the ground.

Of all the remarkable quadrupeds which ranged over continents, one species only now remains alive (and this point even is doubtful)* to connect the historic era, or the present outline of the land with that which preceded it. This is the *Bos Urus (Aurochs)* or primeval ox, whose bones are so frequently associated with those of the mammoth in different parts of Russia and many parts of Europe. But if the species be the same, how has this exception been made, and how have herds of these oxen been preserved in a living state?

* Notwithstanding the deep interest attached to the *Bos Aurochs*, which may, we suppose, prove to be the only existing remnant of the great quadrupeds of former days, there does not exist a single skeleton or stuffed specimen of the species either in France or the British Isles. As far as England is concerned, this reproach is about to be removed through the munificence of the Emperor Nicholas, who, at the request of Mr. Murchison (graciously supported by his Imperial Highness the Grand Duke Michael), has directed that a fine animal, selected from the unique herd now living in the forest called Bialavieja, should be killed, and his skin and skeleton sent to the museum of the Royal College of Surgeons. It may not be known that without a stringent ukase to prohibit its annihilation, the peasantry of Lithuania would long ago have exterminated this noble species. Though we have been led to believe in the specific identity of this Lithuanian Aurochs with the extinct Urus (*Urus priscus* of Bojanus and V. Meyer), that opinion is not generally admitted. But we may hope that the question will be set at rest, as soon as Professor Owen has the means of testing it. If the living Aurochs be the real descendant of the great fossil animal, it might, judging from the usual difference of size, be considered to have degenerated; though in the Museum at Warsaw, where we have seen three specimens which are there preserved, one of them is nearly double the size of the other two. We ourselves procured a very remarkable front and horns of the *Bos Aurochs*, found in the gravel west of Perm, with mammoth's teeth, and M. Hommaire de Hell, also, found a fine head of the same in the steppes between the Sea of Azof and the Caspian.

Looking at the forest of Bialavieja* in Lithuania as the only locality in which this species now exists, and seeing that it is not far from the edge of the southern granitic steppe, we cannot avoid theorizing on a contingency by which some of these creatures may possibly have been preserved. That granitic steppe, the rocks of which we know to be of the highest antiquity, since they have even afforded materials for the construction of some adjacent silurian strata, is in many parts so completely devoid of all superficial covering, and so entirely differs, in that respect, from the thickly overspread tracts upon its north and south, as to justify the inference that it was never depressed beneath the waters since the beginning of palæozoic era, but escaped the submersions which affected all the surrounding regions of Russia in Europe. Some individuals of the *Bos Urus* may therefore, we conceive, have been dwellers in this granitic ridge, until the retirement of the surrounding waters enabled them, or their descendants, to re-people the new jungles and forests of the fresh formed ground; and thus we could explain, by reasoning from geological appearances, how it happens that they are now found living in the forests of Lithuania. Attaching however, no great value to this speculation, which may prove useless, if the living species is found to be different

* Count V. Krasinski, the author of the "History of the Reformation in Poland," prepared, at the request of our friend Colonel Jackson, a very interesting account of this forest and its inhabitants, from which we extract the following data. The forest of Bialawieza (Bialavieja) is in the government of Grondno on the river Narevka, and lying between the towns of Orla, Shereshef, and Prujani, occupies a space of about 29 German, or 145 English square miles. Having been an ancient hunting ground of the kings of Poland, it has been preserved in its wildest pristine state. The Aurochs (*Zubr* in the Polish language) *was always peculiar to Lithuania, if not to this very forest.* According to the earliest records, it was clearly distinguished from the native wild ox or Tur (an animal possibly similar to the wild ox of Chillingham in Northumberland), which appears to have been much more common, even in the sixteenth century, than the *Zubr* or Aurochs. An ancient picture in the possession of the last King of Poland, represents King Ladislaus Jajellem presenting a live Zubr to the fathers of the Council of Constance! thus proving that it was very rare in the beginning of the fifteenth century. (See also *Mem. Descrip. sur la Foret de Bialawieza par le Baron de Brinnen;* published at Warsaw in 1828, at which time, it was believed, that 875 heads of *Zubrs* were still living in the forest.)

from the extinct, we leave it to naturalists to say, whether, under circumstances of great and probably sudden change of land and water; and other difficulties dependent on a limited subsistence, the Aurochs or *Zubr* of Lithuania was not, from his activity and hardy habits, more likely to have survived such oscillations, than his unwieldy associates, the mammoth, mastodon, and rhinoceros.

In terminating the subject of the entombment and dispersion of the great races of Mammalia, we may remind our readers, that in our endeavours to point out the ancient physical geographical features of the Ural Mountains, and the adjacent tracts of Siberia, geological proofs have been adduced to shew, that a vast portion of that region having been entirely exempt from all oceanic influence during ancient periods of long duration, was thereby eminently qualified to be the residence of such animals during the whole of their existence. It has further been proved, that the production of gold veins, and the elevations of the Ural, which have given to these mountains their present height and relief, are phenomena of a comparatively recent date,—phenomena which, in lowering the temperature of the great region so effected, were, we have little doubt, the chief causes of the final destruction of the mammoths, which, with all their adaptation to existence in northern latitudes, could scarcely be supposed to have been capable of long enduring the want of sustenance incident to Siberian winters of the present period.

When we turn from the great Siberian continent, which, anterior to its elevation, was their chief abode, and look to other parts of Europe where their remains also occur, how remarkable is it, that we find the number of these creatures to be justly proportionate to the magnitude of the ancient masses of land which the labours of geologists have defined! Take the British Isles for example, and let all their low recently elevated districts be submerged; let, in short, England be viewed as the comparatively small island she was, when the ancient estuary of the Thames, including the plains of Hyde Park, Chelsea, Hounslow, and Uxbridge, were under the waters,—when the Severn extended far into the heart of the kingdom, and large eastern tracts of the island were submerged, and there will then remain but moderate sized feeding grounds for the great quadrupeds whose bones are found in the gravel of the adjacent rivers and estuaries. This limited area of subsistence could necessarily only keep up a small

stock of such animals; and just as we might expect, the remains of British mammoths occur in very small numbers indeed, when compared with those of the great charnel-houses in Siberia, into which their bones had been carried down during countless ages, from the largest mass of surface which geological inquiries have yet shewn to have been *dry land* during that epoch.

In treating this subject, we have been gradually led on to speculate on features which connect the former with the present surface of a large portion of the earth, and have little other reference to submarine conditions, than the elevation into land of the bottoms of estuaries and sea-shores on the edge of that continent. In the next chapter, however, we must entirely change the scene, by returning to the consideration of Russia in Europe, nearly the whole of whose superficies presents phenomena of a very different class, which, we shall endeavour to shew, can alone have been produced by very powerful currents and long-continued submersion under the waters of of the sea,—phenomena which we think, prevailed during the period when the great mammalia were the inhabitants of Siberia and certain southern tracts to which we have alluded.

P. S.—It may seem remarkable, that in a region like Russia, so extensively tenanted by *bears*, when first reclaimed by man, we should scarcely have alluded to their occurrence during a former condition of the surface. Their bones, however, have been found, as well as those of horses, elks, and many other animals, on whose remains we have not thought it necessary to expatiate, as they are mere repetitions of a phenomenon common to other parts of Europe. Judging from the anology of other countries, where the bones of the Ursus spelæus have usually been found in rocky caverns, it is evident, that, from the nature of her surface, Russia in Europe offers very few spots where the geologist might hope to find them. We have, however, alluded to caverns in the Ural Mountains and Siberia (the caves of Yermac on the Tchussovaya, and others on the Issetz, pp. 365 and 368), which being in positions far above the highest floods, and on precipitous faces of palæozoic limestone, would, if explored by some Russian Buckland, afford, we have little doubt, the remains of extinct animals.—*From Edinb. New Phil. Journal.*

THE

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OF

NATURAL HISTORY.

Contributions towards a Flora of Ceylon. By George Gardner, *Surgeon, F. L. S., Member of the Glasgow Philosophical Society, Corresponding Member of the Royal Botanical Society of Ratisbon, of the Horticultural Society of London, of the Natural History Society of Mauritius, and Superintendent of the Royal Botanical Gardens, Ceylon.*

ORD. NAT. TERNSTROMIACEÆ.

Previous to my arrival in Ceylon only three species of this natural order had been made known to Botanists as natives of the Island, viz. *Eurya Ceylanica,* R.W., *Cleyera lasiopetala,* R.W., which I now refer to *Eurya,* and *Gordonia Ceylanica,* R.W. Since then I have added seven additional ones, all of them new, with the exception of one, *Cleyera gymnanthera,* W. & A., which is likewise a native of the Neilgherry mountains, and the only one of the Ceylon species which ranges beyond the limits of the Island. One of my new species, forming a new genus, was recently published in this Journal under the name of *Carria speciosa,* Gardn. Moon, in his Catalogue of Ceylon plants, enumerates, under the name of *Cistus lobatus, Cochlospermum Gossypinum* DC.,

but it is not truly a native, being only found in the vicinity of temples, and now, moreover, it is removed by Lindley from *Ternstromiaceæ*, and more correctly referred to *Cistaceæ*. Mr. Bennett, in his recent work "on Ceylon and its capabilities," gives a coloured drawing of a species of the genus *Thea*, which he says was found growing wild at Batticaloa, on the east side of the Island. The figure is certainly that of a species of Tea, and resembles much more the Assam than the Chinese plant. During a recent visit which I made to Batticaloa, I did not meet with it in my botanical rambles, nor did any of the English residents there know any thing about it. As I cannot believe Mr. Bennett to be guilty of imposition, I hope that it will some day reward my researches. It is very likely a native of the mountains inland from Batticaloa, which I have not yet visited. If found, it will form a valuable addition to the Flora of Ceylon.

EURYA, *Thunb.*

The genus *Eurya* was established in the year 1789, by Thunberg, in his *Flora japonica*, for the reception of a single species; but since then, and that principally within the last few years, many others have been added to it from the Eastern Islands and various parts of the continent of India. It has not, however, so far as I am aware, even been suspected by botanists that this genus is identical with *Freziera*, a genus established by Swartz, at a later period, in his *Flora Indiæ occidentalis*, for the reception of two West Indian plants. I was first led to suspect that these genera were not distinct from the great resemblance they have in habit; and after a more particular examination of several West Indian and South American species of *Freziera* which I possess, as well as the detailed descriptions and beautiful figures of five species in the "Plantes Equinoxiales" of Humboldt and Bonpland, I do not find a single character by which to distinguish them from the Euryas of the Eastern world. The diœcious cha-

racter ascribed to *Eurya* is not constant, and even if it were, would not constitute a generic distinction. I posses, in my private herbarium, all the hitherto described Indian species but one, besides several undescribed ones; and one of them I find to be truly hermaphrodite, while on the other hand, Macfadyen, in his *Flora jamaicensis*, has lately described a diœcious species of *Freziera*, and I find the same character to belong to a new species from Bolivia. According to Endlicher the embryo of *Eurya* is exalbuminous, and that of *Freziera* albuminous. I find it in both to be enclosed in a thin coating of fleshy albumen. I therefore propose that the two genera should be united, and for which *Eurya*, as being the oldest name, must be retained. *Freziera* may still be adopted as the name of the section under which the hermaphrodite species will rank.

The Eastern species of *Eurya* resemble each other so much in general appearance, that it is a difficult matter to find characters by which to distinguish them. The leaves do not afford good distinctions: more dependance is to be placed on the parts of the flower, but particularly the style and stigmata. The existence or non-existence of hairs on the young shoots, taken along with other characters, is also valuable.

EURYA, *Thunb.*

FREZIERA, *Swartz Fl. Ind. occident.* 2. *p.* 971.—EROTIUM, *Solander ex Swartz Prodr. p.* 85.

SECTION I.—EUEURYA. Flores dioici.

1. EURYA ELLIPTICA, *Gardn.*

E. ramulis teretibus glabris, foliis ellipticis obtusè acuminatis retusis basi obtusis margine subrevolutis mucronato-serrulatis coriaceis glaberrimis, floribus axillaribus geminatis breviter pedicellatis glabris sepalis latè ovato-suborbiculatis obtusis, petalis ellipticis, staminibus 5-6, antheris ovato-

cordatis breviter apiculatis, stylis brevissimis, stigmatibus 3 reflexis.

Hab.—Adam's Peak, at an elevation of about 7,000 feet. Flowers in March.

Descr.—A *shrub* 6-8 feet high, entirely glabrous. *Leaves* shortly petiolate, 2-2½ inches long, 15-18 lines broad.

Obs.—Very distinct from any described species, but seems to approach *E. reticulata*, Krthls., a native of Sumatra.

2. Eurya membranacea, *Gardn.*

E. ramulis teretibus pilosiusculis, foliis oblongo-lanceolatis acuminatis, acumine obtusis retusis, basi acutis membranaceis obtusè mucronato-serratis, costa media subtus pilosiuscula, floribus axillaribus 3-5 breviter pedicellatis glabris, sepalis orbiculatis emarginatis mucronatis, petalis ellipticis, staminibus 12-14, antheris sagittatis acutis, stylis brevis, stigmatibus 3 reflexis.

Hab.—Elephant plains, and on the descent from the Horton plains to Galagama. Flowers from October to February.

Descr.—A large straggling *shrub*, with slender branches. *Branchlets* round, slightly pilose. *Leaves* shortly petiolate, 2½-4 inches long, 10-18 lines broad.

Obs.—This species resembles *E. angustifolia*, Wall., but the structure of the flower is very different. It is perhaps too closely related to the following species.

3. Eurya ceylanica, *R. W.*

E. ramulis teretibus pilosis, foliis oblongis acuminatis, acumine obtusis retusis, basi acutis coriaceis margine revolutis obtusè mucronato-serratis, costa media pilosa, floribus axil-

laribus 2-4 breviter pedicellatis glabris, sepalis rotundatis emarginatis, petalis obovatis, staminibus 14, antheris oblongis obtusis, stigmatibus 3 subsessilibus reflexis, baccâ globosâ pilosiusculâ.

Eurya *Ceylanica, R. Wight, Illust. of Ind. Bot.* 1, *p.* 98.

Hab.—Pussilawa, Newera Ellia, and Adam's Peak, at an elevation of from 3,000 to 7,000 feet. Flowers all the year.

Descr.—A *shrub* 12-16 feet high. *Branchlets* round, pilose. *Leaves* shortly petiolate, 2-3½ inches long, 12-18 lines broad.

4. Eurya parvifolia, *Gardn.*

E. ramulis subflexuoso-ancipitis pilosis, foliis parvis obovato-ellipticis obtuse acuminatis retusis margine valdè revolutis acutè mucronato-serratis, floribus axillaribus 2-3 subsessilibus, sepalis orbicularibus emarginatis glabris, petalis obovatis, staminibus 9, antheris ovato-cordatis obtusis.

Hab.—Common on the margins of streams between Newera Ellia and the Horton plains. Flowers in February.

Descr.—A *shrub* 3-12 feet high. *Branches* round, covered with black patent hairs. *Leaves* shortly petiolate, 9-15 lines long, 6-8 lines broad, glabrous, or with the mid-rib occasionally slightly pilose.

Obs.—A very distinct species, easily recognised by its somewhat two-edged branchlets and small leaves.

To this Section also belongs all the Indian species with which I am acquainted, viz. *E. acuminata*, DC., *E. angustifolia*, Wall., *E. Roxburghii*, Wall., *E. tristyla*, W. and A., *E. Wightiana*, Wall., besides what I believe to be two new species from the Neilgherries, two which I possess from

Griffith from Malacca, *Freziera dioica,* Macf., and Pentland's n. 193 from Bolivia.

SECTION II.—FREZIERA. Flores hermaphroditi.

5. EURYA LASIOPETALA, *Gardn.*

E. arborea, foliis oblongo-lanceolatis obtusis vel subacuminatis retusis margine revolutis minutè denticulatis glabris, floribus axillaribus solitariis, pedicellis elongatis cernuis apice incrassatis, petalis extus sericéo-tomentosis, staminibus numerosis, antheris linearibus mucronatis pilosis, stylis elongatis filiformibus, stigmatibus 3 cylindricis obtusis, baccâ globosâ.

Cleyera *lasiopetala, R. W., Illust. Ind. Bot.* 1. *p.* 99.

HAB.—Rambodde pass, Newera Ellia, and the Horton plains, at an elevation of from 5,000 to 6,000 feet. Flowers in May.

DESCR.—A *tree* 20-30 feet high. *Branches* round. *Leaves* alternate, petiolate, pennivenous, with coarse reticulations, about 4 inches long, and from 9-12 lines broad, the margins very much revolute at the base. *Pedicels* 10 lines long. *Calyx* bibractiolate at the base. *Sepals* 5, free, imbricate, roundish, nearly equal, reticulated, margins membranous, externally sericeo-pilose, $4\frac{1}{2}$ lines long. *Petals* 5, hypogynous, alternating with the calycine segments, between elliptical and orbicular, slightly cohering at the base, sericeo-tomentose externally, except the margins which are glabrous, 6 lines long, with an imbricated æstivation. *Stamens* numerous, adhering in a single series to the base of the petals : *filaments* complanate, 2 lines long. *Anthers* introrse, linear, 2-celled, mucronate, covered with scattered erect hairs, attached by the base, and dehiscing longitudinally. *Ovary* free, 3-celled. *Ovules* numerous, campylotropous, attached to two placentas which project from the inner angles of the cells. *Style* filiform : *stigmas* 3, cylindrical, obtuse. *Berry* dry, globose, 5 lines in diameter, crowned by the persistent style, 3-celled, but apparently 6-celled, from the protruded plantæ reaching nearly to the outer

parietes of the cells. *Seeds* numerous, pendulous, somewhat ovate, flattened: *testa* crustaceous, black, pitted, shining. *Embryo* cylindrical, homotropous, curved in the axis of scanty fleshy albumen: *Cotyledons* and *radical* superior.

Obs.—This tree was some years ago described by Dr. Wight as a *Cleyera*, but its single series of stamens and numerous ovules and seeds distinguish it from that genus. It agrees perfectly with *Eurya*, and is the largest flowered species I am acquainted with.

To this section also belongs the seven species of *Freziera* described in DeCandolle's Prodromus, and *F. integrifolia*. Benth. in Plant. Hart. 18.

CLEYERA, *Thunb.*

1. Cleyera emarginata, *Gardn.*

C. tota glabra, ramulis dichotomis, foliis obovatis vel elliptico-oblongis obtusis emarginatis basi cuneatis coriaceis margine valdè revolutis integriusculis vel versus apicem subcrenulato-serratis, floribus axillaribus solitariis ebracteolatis, sepalis petalisque glabris, antheris glabris apice emarginatis, stylis 2 distinctis.

a. Latifolia, foliis late obovatis indistincte crenulatis.

β. Angustifolia, foliis elliptico-oblongis crenulato-serratis.

Hab.—Var. *a.* Margins of streams between Adam's Peak and Newera Ellia: Var. *β.* Banks of streams Horton plains. Flowers in February and March.

Descr.—*A shrub* 10-16 feet high, *Branches* dichotomous, round. *Leaves* crowded at the ends of the branchlets, alternate, petiolate, obovate, or elliptical-oblong, obtuse emarginate, cuneate at the base, margins revolute, obtusely crenato-serrated from the middle up-

wards, coriaceous, glabrous, veinless, $1\frac{1}{2}$-$2\frac{1}{2}$ inches long, 9-15 lines broad, dark green and shining above, pale green beneath: ***Petiole*** flattened, 2-4 lines long, of a purplish colour. ***Pedicels*** axillary, solitary, terete, glabrous, 9 lines long, of a purplish colour. ***Calyx*** bractless, free: ***Sepals*** 5, roundish, concave, glabrous, imbricated, of a yellowish colour tinged with purple, unequal, the largest ones about 2 lines long. ***Petals*** 5, hypogynous, roundish, concave, imbricated, of a pale yellow colour, the outer ones tinged with purple, about 4 lines long. ***Stamens*** numerous, hypogynous, in several series: *filaments* flat, scarcely a line long. ***Anthers*** continuous, linear-oblong, introrse, 2-celled, cells bursting longitudinally, separated by a broad connective, which is terminated by a broad emarginate appendix. ***Ovary*** superior, conical, glabrous, 2-celled, with 2-collateral ovules suspended from the top of the dissepiment. ***Styles*** 2, short. ***Stigmas*** broadly subreniform, with undulated margins. ***Fruit*** unknown.

Obs.—This plant differs from the genuine species of the genus in the want of bracts to the calyx, and having two distinct styles, each of which bears a large subreniform stigma with undulated margins, but otherwise the structure is the same. The two varieties above described appear to be very distinct species, and at first I considered them as such, but on more attentive examination, could not find characters by which to distinguish them.

GORDONIA, *Ellis.*

1. Gordonia elliptica, *Gardn.*

G. Arborea glaberrima, foliis sessilibus exactè ellipticis utrinque obtusissimis margine subrevolutis integerrimis apice emarginatis coriaceis supra venoso-reticulatis subtus eveniis, floribus axillaribus sessilibus, sepalis orbicularibus emarginatis extus puberulis margine ciliatis, petalis 5 obcordatis extus puberulis basi coalitis, antheris oblongis, ovario sericeo-piloso,

stigmatibus 5 radiatis, capsulis oblongis pentagonis pilosiusculis.

Hab.—Forests near the Elephant plains. Flowers in October.

Descr.—A large *tree*. *Branchlets* round, glabrous, with the leaves crowded at their extremities. *Leaves* nearly quite sessile, 3-3½ inches long, 2 inches broad. *Flowers* white, 2 inches in diameter. *Capsule* woody, 15 lines long, 5-celled, with a loculicidal dehiscence. *Seeds* unknown.

Obs.—Near *G. Ceylanica*, R. W., from which it is principally distinguished by its glabrous, not pilose, branchlets, its very differently shaped leaves, which are broadest, not narrowest, at the base, and more sessile and larger flowers. In some of my specimens of *G. Ceylanica* there is a slight appearance of serratures on some of the leaves, thus approaching it to the Neilgherry *Gordonia obtusa*, which however, is a very distinct species.

ORD. NAT. FLACOURTIACEÆ.

ROUMIA, *Poit.*

1. Roumea hebecarpa, *Gardn.*

R. arborea inermis, foliis petiolatis ovato-oblongis vel oblongo-lanceolatis acuminatis basi obtusis integris vel dentato-serratis penniveniis supra nitidis pubescentibus subtus pallidis tomentosis, pedicellis axillaribus paucis, baccis globosis pubescentibus.

Hab.—Rare in the jungles of the Central Province, as at Cundasalle. Flowers in June.

Descr.—A diœcious *tree,* 16-20 feet high. *Branches* round, ash coloured, warted, the younger ones pubescent. *Leaves* alternate, petiolate, ovate-oblong, varying to oblong-lanceolate, acuminate, obtuse at the base, entire or dentate-serrate, pennivenous, veins about six on each side, green, shining, and minutely pubescent above, pale and tomentose beneath, about 4 inches long, by about 20 lines broad. *Male flowers : Peduncles* axillary, very short, often geminate. *Pedicels* rather numerous, umbellate, about 4 lines long, pubescent. *Calyx* deeply 5-7 parted, lobes lanceolate, acute, pubescent. *Petals* none. *Stamens* numerous : *filaments* filiform, as long as the calycine segments : *anthers* introrse, obtuse, 2-celled, dehiscing longitudinally. *Hypogynous disk* none. *Female flowers : Pedicels* axillary, solitary, or two or three together. *Calyx* 5-7 parted, lobes ovate-lanceolate, acute, pubescent, persistent, about $3\frac{1}{2}$ lines long. *Ovary* sessile, free, surrounded at the base by a crenulated annular *disk,* densely pilose-pubescent, subglobose, 1-celled, with from 5-7 parietal placentæ reaching nearly to the axis, which they ultimately do in a more advanced stage. *Ovules* one on each side of each placenta, anatropous. *Styles* 6-7, about $1\frac{1}{2}$ lines long, divergent, pilose-pubescent : *stigma* radiately fimbriated. *Fruit* a globose, brownish-purple, many seeded berry, about an inch in diameter, pubescent, crowned by the persistent styles. *Seeds* in an external and internal series, those in the external one, somewhat triangular and pendulous, those in the internal, ovate compressed, with their narrow ends towards the axis, and suspended from a curved cord which proceeds from the base of the fruit, surrounded on their margins by a pellucid wing consisting of agglutined fibrillæ : *testa* membranous, villous. *Embryo* in the axis of thin fleshy albumen, orthotropous : *Cotyledons* foliaceous, orbicular, cordate : *radical* terete, obtuse, directed towards the hilum.

Obs.—The only hitherto described species of *Roumea* is a native of St. Domingo, in the West Indies, for the *R. inermis* of DeCandolle from Bengal seems to belong to a very different family. The present species is called *Katambilla* by the Cingalese, and the fruit, which is very acid, is used by them in their curries.

ERYTHROSPERMUM, *Lam.*

1. Erythrospermum phytolaccoides, *Gardn.*

E. arborea, foliis sparsis petiolatis oblongo-lanceolatis acuminatis basi acutis utrinque glaberrimis integris vel obscurè subserratis, racemis paniculatis axillaribus terminalibusque folio subæquantibus, sepalis ovatis obtusis concavis, petalis ovato-oblongis ciliatis, staminibus 5, antheris sagittatis.

Hab.—Woods between Balangoda and Palmadulla, in the Saffragam district, February 1846.

Descr.—A *tree* 20-30 feet high. *Branches* round, glabrous, the younger ones greenish, warted. *Leaves* alternate, petiolate, from ovate-oblong to oblong-lanceolate, acuminate, acute at the base, entire or obscurely subserrated, glabrous, pennivenous, veins somewhat prominent beneath, intervenium widely reticulated, dark green and shining above, yellowish green beneath, $4\frac{1}{2}$-6 inches long, 18-27 lines broad: *petiole* 6-8 lines long, convex on the under surface, channelled above, thickened both at the base and apex. *Stipules* small, lanceolate, acute, deciduous, of a reddish colour. *Racemes* paniculate, axillary, bluntly angled, glabrous, many flowered, of a whitish colour, and about as long as the leaves. *Pedicels* about 2 lines long, with three minute, acute, glandularly serrated bracteoles at the base. *Calyx* free; *sepals* 5, ovate, obtuse, concave, of a yellowish white colour, tinged occasionally with red, about 2 lines long. *Petals* 5, hypogynous, ovate-oblong, obtuse, ciliated, of the same length as the sepals, white. *Stamens* 5, alternate with the petals: *filaments* very short flattened: *anthers* sagittate, about $1\frac{1}{2}$ lines long, 2-celled, cells marginal, opening longitudinally, widely separated by a broad thin fleshy connective. *Ovary* free, ovate, glabrous, 1-celled, with numerous ovules attached to 3-parietal placentæ. *Style* short, of a reddish colour: *stigma* 3-lobed, lobes linear, obtuse. *Fruit* unknown.

Obs.—This is the only species of *Erythrospermum* which has yet been found in Ceylon, and, indeed, with the exception of a variety of *E. ellipticum*, which DeCandolle describes from Java, is the only one which has been found to the eastward of the Mauritius and Bourbon, those Islands being the focus of the genus.

ORD. NAT. HOMALINEÆ.

BLACKWELLIA, *Commers.*

1. Blackwellia Ceylanica, *Gardn.*

B. foliis petiolatis oblongo-ellipticis acuminatis basi acutis crenato-dentatis glabris nitidis, spicis axillaribus longissimis nutantibus, floribus subpentameris.

Hab.—In forests of the Central Province, at an elevation of about 3,000 feet. Flowers in April.

Descr.—A *tree* 20 feet high. *Leaves* alternate, the acuminated apex entire obtuse, pennivenous, with the veins prominent on both sides, and the intervenium finely reticulated, 4-4½ inches long, 1½-2 inches broad. *Spikes* 6-9 inches long, densely floriferous. *Flowers* about 3 lines in diameter, of a pale greenish colour, arranged in fascicles, shortly pedicellate. *Calyx* adherent, the *limb* with from 8-12 divisions in two series: those of the *external* series oblong, obtuse, pubescent and ciliated, with an elevated horizontal brown gland at their base inside: those of the *internal* series obovato-oblong, obtuse, pubescent, ciliated, and longer than the external ones. *Petals* none. *Stamens* equal in number with the inner segments of the calyx, opposite to them, and adhering to their base: *filaments* filiform, glabrous, erect; *anthers* subglobose. *Ovary* 1-celled, with numerous ovules attached to parietal placentæ, which latter are equal in number with the styles. *Styles* 4-6, filiform, spreading. *Fruit* unknown.

Obs.—This, the only species indigenous to Ceylon, comes near to *B. spiralis,* Wall., but in it the leaves are subsessile, much larger, and pubescent on the under surface.

ORD. NAT. PROTEACEÆ.

HELICIA, *Lour.*

1. Helicia Ceylanica, *Gardn.*

R. foliis alternis petiolatis elliptico-obovatis obtusissimis integris apice emarginatis basi cuneatis glabris, racemis axillaribus, folio subæquantibus, pedicellis geminatis perianthiis ovariisque glabris.

Hab.—Banks of the Massnawatté in the Ambegamoa district. Flowers in February.

Descr.—A *tree* about 20 feet high, glabrous in all its parts. *Leaves* 4-6 inches long, $1\frac{1}{2}$-2 inches broad. *Raceme* 3-4 inches long, together with the pedicels of a very dark purple colour. *Pedicels* geminate, 3 lines long. *Perianth* clavate in the unexpanded state, of a pale yellow colour, and about 9 lines long: *divisions* 4, recurved, each bearing a stamen on its inner surface a little below the apex. *Anthers* sessile linear, 2-celled. *Style* filiform: *Stigma* clavate. *Hypogynous glands* 4, distinct, obtuse. *Ovary* 1-celled, with 4 erect, superimposed ovules attached to a parietal placenta.

Obs. I.—This species seems to approach *Helicia Moluccana,* Blume (*Rhopala Moluccana,* R. Br.), but judging from the description, that species has much longer petioles, and the leaves are not emarginate at the apex. The ovary in that species, moreover, has only two ovules, while in mine there are four.

Obs. II.—The genus *Helicia* represents in the Eastern world the *Rhopalas* of Equinoctial America, and is distin-

guished from them by its erect ovules, indehescent fruit, and wingless seeds. Of the eight species which I find recorded in Botanical works, one is a native of Cochin China, five of the Eastern Islands and the Straits of Malacca, and two of Silhet. The present species, the only one hitherto discovered in Ceylon, has the most Westerly range of any of the genus, none as yet having been found in the peninsula of India.

ORD. NAT. THYMELACEÆ.

DAPHNE, *Linn.*

1. Daphne inamœna, *Gardn.*

D. foliis breviter petiolatis oblongis acutis basi subcuneatis utrinque adpressè piloso-pubescentibus subtus pallidis reticulatis, racemis axillaribus multifloris folio brevioribus, floribus pubescentibus.

Hab.—Margins of woods at Newera Ellia, at an elevation of about 6,000 feet. Flowers nearly all the year.

Descr.—A *shrub* 6-8 feet high with erect slender branches. *Branches* round, the younger one pilose-pubescent. *Leaves* alternate, shortly petiolate, oblong, acute, narrowed towards the base, entire, adpressly pilose-pubescent on both sides, the under surface pale, reticulated, 1½-2 inches long, 6-9 lines broad : *petiole* 1 line long, pilose. *Racemes* axillary, shorter than the leaves, about 12 flowered. *Flowers* shortly pedicellate. *Perianth* a cylindrical *tube* about 3 lines long, pubescent, and of a yellowish green colour, with a 4-parted *limb*, the lobes of which are small, ovate, obtuse, and spreading. *Stamens* 8, in two rows at the upper part of the tube : *filaments* very short : *anthers* oblong, yellow. *Ovary* free, pilose, shortly pedicellate, 1-celled, with a single pendulous ovule. *Style* very short. *Stigma* globose. *Drupe* dry, oblong, enclosed in the

persistent tube of the perianth, about $1\frac{1}{2}$ line long, containing a single seed: *putamen* black, crustaceous. *Seed* inverse: *albumen* none: *Embryo* orthotropous: *Cotyledons* plano-convex: *radical* short, superior.

HAB.—A very distinct species from any of those hitherto described.

GNIDIA, *Linn.*

Some very interesting links connecting the Flora of Western India with that of Southern Africa have lately been made known by Dr. Wight. Thus in the last part of his "Icones Plantarum," (Vol. iii, part 4,) he has published drawings and descriptions of a species of *Vogelia* and of *Apodytes*,* both African genera hitherto unknown in India. This connection will be further illustrated by the present article. All the hitherto published species of *Gnidia* are natives of South Africa, but I have now to make known three Indian species, one of which is peculiar to Ceylon, another to the Neilgherry mountains, and a third common to both countries. One of them has long been known to Botanists by the name of *Daphne eriocephala*, that being the appellation given to it by Dr. Wallich in his "Catalogue," but, so far as I am aware, no description of it, or of any of the others, has yet been published. According to Wallich the same plant was referred by Heyne to *Lachnæa*, but it, as well as the other two, differ from both these genera in having faucial scales. With *Gnidia*, to which I now refer them, they agree in every thing except the number of the parts of the flower, the African species being tetramerous, while the Indian ones are pentamerous. This, however, is not of sufficient importance to exclude them from the genus, of which they will form a section, and to which I propose to give the name of *Dingia*,

* I have lately met with the same or an allied species in Ceylon.

an anagram of *Gnidia*. The two sections may be characterized thus:—

Sect. I. Eugnidia.—Flores tetrameri.

Sect. II. Dingia.—Flores pentameri.

Two only of the species, as already observed, are natives of Ceylon, but I add also a description of the Neilgherry plant, so that all the known Indian species may stand together.

1. Gnidia (Dingia) insularis, *Gardn.*

G. fruticosa, ramis dichotomis sericeo-villoso-tomentosis, ramulis ad apicem foliosis, foliis alternis breviter petiolatis lineari-lanceolatis obtusis mucronatis supra villosis vel glabriusculis subtus sericeo-villosis, capitulis terminalibus multifloris involucratis, involucri squamis oblongis acutis utrinque sericeis, floribus pentameris extus sericeo-villosis.

Hab.—In open jungle on the Hautane range, at an elevation of from 2-3000 feet. Flowers in February and March.

Descr.—A *shrub* 8-12 feet high. *Leaves* $2\frac{1}{2}$ inches long, 5-8 lines broad, a little narrowed towards the base, membranous entire. *Involucral scales* about 6 lines long. *Tube* of the *perianth* tubular, 6 lines long, the lower half covered with long white silky hairs, the upper half with much shorter ones: *limb* 5-parted, *lobes* oblong, obtuse, glabrous internally, externally covered with long white silky hairs. *Faucial scales* 5, inserted between the bases of the segments of the perianth, oblong, slightly oblique at the apex. *Stamens* 10, in two series, the lower ones included, the upper exserted: *anthers* linear. *Style* lateral, filiform, included: *stigma* capitate, rough: *ovary* free, pedicellate, pilose, 1-celled, with a single pendulous ovule.

2. Gnidia (Dingia) eriocephala, *Gardn.*

G. fruticosa, ramis dichotomis glabriusculis, ramulis foliosis, foliis alternis breviter petiolatis lanceolatis acutis mucronatis

versus basim subcuneatis utrinque glabris, capitulis terminalibus multifloris involucratis, involucri squamis ovato-lanceolatis acutis utrinque sericeis, floribus pentameris extus sericeo-villosis.

Lachnæa *eriocephala, Heyne ex Wall.*

Daphne *eriocephala, Wall. Cat. n.* 1051. (Sine descriptione.)

Hab.—In open jungle at Galagama, in the district of Saffragam, Ceylon. Common also on the Neilgherry mountains, peninsula of India. Flowers in February and March.

Descr.—A *shrub* 8-12 feet high. *Leaves* $3\frac{1}{2}$-$4\frac{1}{2}$ inches long, 8-12 lines broad, green above, pale beneath, pennivenous, with the intervenium finely reticulated, membranous entire. *Involucral scales* 6-7 lines long, 3 broad, acute, with the margins above undulated. *Tube* of the *perianth* tubular, 6-7 lines long, the lower half covered with long white silky hairs, the upper half with much shorter ones: *limb* 5-parted: *lobes* elliptical, very obtuse, glabrous internally, sericeous externally. *Faucial scales* 5, inserted between the bases of the segments of the perianth, obovate, truncate, and occasionally 2-3-dentate. *Stamens* 10, in two series, the lower ones included, the upper exserted: *anthers* linear. *Style* lateral, filiform, included: *stigma* capitate, somewhat hispid. *Ovary* free, pedicellate, pilose at the apex, 1-celled, with a single pendulous ovule.

Obs.—This species is readily distinguished from the preceding one by its glabrous, not silky, branchlets, very much larger and glabrous leaves, and differently shaped faucial scales. The hairs also on the external surface of the lobes of the perianth are much longer.

3. Gnidia (Dingia) sisparensis, *Gardn.*

G. sub-arborea, ramis dichotomis, ramulis glabris ad apicem foliosis, foliis alternis subsessilibus oblongis obtusis vix retusis utrinque glabris, capitulis terminalibus multifloris in-

volucratis, involucri squamis ovato-oblongis obtusis utrinque sericeis, floribus pentameris extus sericeo-villosis.

Hab.—Margins of woods near the top of the Sispara pass, Neilgherry mountains: *Wight and Gardner.* Flowers in February.

Descr.—A small *tree. Leaves* 2-2½ inches long, 9-12 lines broad, green above, pale beneath, entire, slightly retuse at the apex, pennivenous, with a rather coarsely reticulated intervenium. *Involucral scales* 6 lines long, 3½ broad, very obtuse. *Tube* of the *perianth* tubular, rather infundibuliform upwards, 6 lines long, the lower half covered with long brownish coloured hairs, the upper half with much shorter ones: *limb* 5-parted: *lobes* elliptical, obtuse, internally glabrous, externally covered with long brownish hairs. *Faucial scales* 5, inserted between the bases of the segments of the perianth, obovate, somewhat 2-lobed. *Stamens* 10, in two series, the lower ones included, the upper exserted: *anthers* linear-oblong. *Style* lateral, filiform, included: *stigma* capitate, hispid. *Ovary* free, pedicellate, covered, particularly at the apex, with long brown hairs, 1-celled, with a single pendulous ovule.

Obs.—This is a very distinct species from the other two, its broad short leaves, and brown perianthal hairs distinguishing it at first sight.

ORD. NAT. TACCACEÆ.

Trichopus, *Gaert.*

Char. Gen.—*Flores* hermaphroditi. Perianthium corollini tubus cum ovario connatus, limbus superus, 6-partitus, sub-æqualis, patens, persistens. *Stamina* 6, basi laciniarum limbi inserta: *filamenta* brevissima, medio incrassata: *antheræ* introrsæ, subreniformes, biloculares, loculis parallelis valdè discretis, connectivo pellucido apice longe apiculato, extus ad basim bidentato. *Ovarium* cum perianthii tubo connatum,

alato-triangulare. *Ovula* 2, in loculorum angulo centrali superposita, pendula. *Styli* 3, breves, carnosi, complanati, erecti: *stigma* bilobata, lobis obovatis, complanatis, obtusis reflexis. *Capsula* obovata, alato-triangulata, 3-locularis, loculis disperma. *Semina* super-imposita, ex angulo centrali loculorum pendula, subovata, compresso-subtriquetra, rugosa, hinc gibba, inde sulco longitudinali exsculpta: *testa* tenua, membrancea, arctissima nucleo adnata. *Embryo* orthotropus, in sulco basi albuminis cornei minimus, extremitate radiculari albumen perforante et umbillicum attigenti, e vitello exserta, nec ab albumine inclusa.

Herba *Ceylanica;* foliis *longe petiolatis, linearibus, lanceolatis, vel ovato-cordatis, triplinerviis, reticulatis,* petiolis *medio floriferis,* pedicellis *unifloris,* floribus *purpureus.*

1. Trichopus *Ceylanicus, Gaert.* 1. 44. *t.* 14.—*Trichopodium cordatum, intermedium, et angustifolium, Lindl. in Bot. Reg. Sub. Fol.* 1543.

Hab.—On shady banks in the Western and Southern Provinces. Abundant at the foot of Adam's Peak. Flowers in March.

Descr.—*Herbaceous,* 9-15 inches high. *Caudex* short, repent, radicant, scaly: *scales* scarious, ovato-lanceolate, acuminate, brownish, about 5 lines long. *Roots* fibrous, yellowish. *Leaves* sub-cæspitose, with very long petioles, from linear to ovato-cordate, obtuse, emarginate, and apiculate at the apex, acute, obtuse or subcordate at the base, entire, glabrous, 3-nerved, with the nerves prominent beneath, intervenium coarsely reticulated, from $3\frac{1}{2}$-5 inches long, exclusive of the petiole, and from half an inch to 3 inches broad: *petiole* 6-9 inches long, geniculate above the middle, the *lower* portion terete, striated, glabrous, the *upper* subtriangular, striated, glabrous, channelled on its upper face. *Pedicels* arising from the base of the upper portion of the petiole on its internal face, 1-3, but with the remains of pre-existing ones, slender, terete, glabrous, 12-15 lines long, 1-flowered. *Perianth* adherent; *tube* obovate, triangular, the angles winged, green-

ish: *limb* spreading, 6-lobed, in two series, lobes of the external series ovate-lanceolate, acute, apiculate, those of the inner series ovate, acute, apiculate, both of the series nearly equal in length, about 2 lines long, and of a purple colour. *Stamens* 6, inserted on the base of the segments of the perianth: *filaments* very short, thickened in the middle, white: *anthers* introrse, subreniform, 2-celled, cells widely separated by a thin pellucid connective, which is bidentate externally at the base, and terminated by a long linear, obtuse apiculous. *Ovary* inferior, triangular, glabrous, 3-celled, each cell containing two super-imposed ovules, which are attached by their middle to the inner angle. *Styles* 3, very short, fleshy, conniving, flattened: *Stigma* 2-lobed, lobes obovate, flattened, obtuse, reflexed, white. *Capsule* obovate, triangular, the angles somewhat 3-winged, 3-celled, each cell containing 2 super-imposed seeds. *Seeds* attached by the middle to the inner angles of the cells by a brown filiform umbilical cord. They are of a compressed ovate, or subtriangular shape, with their broad ends truncated, and these are opposed to each other, the narrow ends pointing the one to the apex of the capsule, the other to its base. The *testa* which is very thin, and adheres firmly to the horny albumen, is of a yellowish brown colour, and pilosely pubescent. The *albumen* consists of a broad oblong plate, very horny, which is rolled up longitudinally, leaving an open salcus along the whole length of the seed on one of its sides, and that margin which is next the placenta has a transverse slit in the middle of it, through which the umbilical cord passes, and at the bottom of which the embryo lies imbedded in the albumen, but not entirely, for the radical which points towards the hilum is protruded beyond it, but cannot be seen till the base of the umbilical cord is removed. The *embryo* is very small, the *radical* short, acute, and enclosed in the vitellus, and the single cotyledon is truncated.

Obs. I.—As no exact description of this very curious plant has hitherto been published, I conceive that the above details, made on the spot from recent specimens, will be valuable to Botanists. I have preferred retaining Gaertner's name rather than adopting the modification of it which Lindley has proposed in the Botanic Register. Three species are

established by Lindley, characterized principally by the shape of the leaves, but I believe them all to be variations of the same plant. They may all be seen growing together, and, indeed, the leaves vary very much on the same plant.

Obs. II.—Lindley refers *Trichopus* to the natural order *Aristolochiaceæ*, but from the above description it will be seen, that there is the most perfect resemblance between its reproductive organs and those of *Tacca*, with the exception of the economy of the capsule, which is a little different. We have, first of all, the adherent tube of the perianth and petaloid limb of *Tacca*, then the six distinct stamens inserted into the base of the segments of the perianth, the dilated filaments, and the *introrse anthers* with their parallel cells separated by a wide connective. In *Tacca*, however, the ovary is 1-celled, with numerous ovules attached to three parietal placentæ, while in *Trichopus* it is 3-celled, with only two ovules in each cell. But if we look at the structure of *Ataccia*, the close ally of *Tacca*, we there find that the placentæ are so much protruded from the walls that they almost reach the axis, and hence it is all but 3-celled. A little further protrusion would make it a truly 3-celled ovary, with the ovule attached to the inner angles of the cells. The fruit in *Tacca* and *Ataccia* is said to be baccate and indehiscent. In *Trichopus* it is capsular, but I have not ascertained in what manner it dehisces. The figure which Gaertner gives of the seed of *Trichopus* is very good, but that which he has taken for the embryo is the lower end of a membranous carunculus or aril which fills the latteral sulcus, and generally projects a little at the broad end of the seed. The embryo appears to be truly monocotyledonous.

So far then as the reproductive organs are concerned, I think there can be but little doubt that *Trichopus* has much greater affinity with *Taccaceæ* than with *Aristolochiaceæ*. As regards the habit of the plant it is somewhat peculiar, but not unlike that of some species of *Anthurium*, a

further evidence of the relation which exists between *Taccaceæ* and *Orontiaceæ*. The mode of inflorescence, though at first sight very different from that of *Tacca*, is in reality nearly quite the same, or at all events, is not greater than that which exists between *Anemia* and *Mohria*. In *Trichopus* the lower half of the petiole is evidently not simple, but formed by the union of it and a peduncle similar to the one in *Tacca*, which is shown by the united portion being round, while the upper, or true petiole, is channelled on its anterior face. The pedicels, then, arise from a sessile umbel, and the involucre of *Tacca* is represented by the scales which surround their bases.

Obs. III.—Jussieu placed *Tacca* at the end of his *narcissi*, remarking that it resembled *Aroideæ* in habit, but was otherwise distinct. Brown was the first (*Prod. p.* 340) to point out its intermediate character between *Aroideæ* and *Aristolochiaceæ*, and nearly all succeeding writers on the subject have adopted this view. The most material difference between *Aroideæ* and *Taccaceæ* is the adherent ovary of the latter, but this is only another example of the many which exist where orders that agree in every thing else differ in this respect, and by some systematists are widely separated in consequence. For example, we find this to be the case with *Ericaceæ* and *Vacciniaceæ*, with *Gesneriaceæ* and *Cyrtandraceæ*, and with *Cinconaceæ* and *Loganiaceæ*. Blume considers (*Enumer*. 1. 82) that by the superior perianth of *Tacca* the affinity with *Aristolochiaceæ* is evident; while Lindley (*Veg. King*. 149.) says that to him the resemblance seems to be so slight as to be unworthy of notice. For my own part I conceive that the relationship is most completely established through *Trichopus*, which with the habit of *Anthurium* has the stamens of *Tacca*, and the capsule of *Asarum*.

Kandy, Ceylon: 24th Sept. 1846.

On two new Ceylon plants related to SCIAPHILA *of Blume. By Capt.* J. G. CHAMPION, *95th Regt.*

[Communicated by G. Gardner, Esq., M.D.]

[The two little plants, descriptions of which my friend Capt. Champion has communicated to me for publication in this Journal, are certainly very distinct from anything of the kind hitherto described, and are, as he states, evidently related to the little known *Sciaphila* of Blume, a native of Java, the Flora of which Island bears very intimately on that of Ceylon. It is now nearly two years since I accompanied Capt. Champion to the locality where these plants grow, and was then struck with the resemblance which they bear in habit to some small plants, natives of Brazil, which a few years ago, I formed into a distinct family under the name of *Treuridaceæ.* Capt. Champion alludes to this resemblance, but nothing is known of their seeds, and the economy of the male organs is totally different from that of the present plants. Capt. Champion believes that they ought to form the type of a distinct order, but I can find no marks by which they are to be distinguished from *Artocarpaceæ,* except, indeed, their habit, which certainly forms a great contrast to that of such trees as the jack and bread fruit, but that of itself is not sufficient to exclude them from the order, of which they will constitute a section. The numerous carpels of these little plants would seem to form a distinction between them and the *Artocarpus* tribe, but in the latter they are not always solitary, two being generally found in *Brosimum.*

Capt. Champion does not state where the point of attachment of the seed is within the utricule. In *Hyalisma ianthina* I find it to be at the upper part of the parietes as in *Artocarpus,* not, however, as in it on the side which bears the style, but on the opposite one. The embryo I find lying on the outside of a thin fleshy albumen, or but very slightly covered with it, on the side of the seed opposite to the raphe, nearly straight, and with the radical directed towards the hilum. The radical is short, conical, and of a brownish colour: the cotyledons elliptical, compressed, and white.—G. G.]

I enclose descriptions of two minute but interesting plants, with which I have been acquainted for some time, but which do not appear to have been known to the botanists who had

previously explored the Southern Province of Ceylon, possibly because they are so minute as not to be readily observed, and also from their being restricted, as far as my observation goes, to particular localities. I do not think, that any botanist can read the description of Sciaphila, as described by Blume, without feeling convinced of the very near affinity of it to my genus Aphylleia, and it is with Sciaphila, I feel but little doubt, that my plants range. Endlicher arranges Sciaphila after Artocarpeæ, amongst the "genera vix nota," adding "affinitas plane obscura," and the difficulty of its classification is increased by Blume's not having mentioned the structure of the seed, which, if resembling that of my genera Hyalisma and Aphylleia, would bring his plant nearer to the Moreæ than to the Artocarpeæ. From both Moreæ and Artocarpeæ, these plants may, however, be entirely separated, because they are not lactescent, and it seems to me, that it will be more natural to form of them a new group than to place them amongst either of two orders, which, with the exception of Dorstenia, are all shrubs or trees of large size, and very different habit. From Urticaceæ Proper they are readily separated by the stamina, which are so remarkable in the Nettle tribe for being inflexed when young, and when older for the irritable and elastic mode of their development; in habit they are nearer to Urticaceæ than to either Moreæ or Artocarpeæ.

Amongst the Moreæ I do not recognise any genus resembling the plants under consideration. Dorstenia is probably nearest, but very different. Amongst the Artocarpeæ, Brosimum is remarkable for having stamina which burst after the same method. The lateral style is peculiar, but common both amongst Moreæ and Artocarpeæ. That of Sciaphila is said to be sessile and punctiform, which is more after the fashion of Urticaceæ.

I shall therefore not feel surprised to find botanists ranging Sciaphila, Hyalisma, and Aphylleia, next indeed to the

Moreæ, but in a new group, distinguished from that order by its being elactescent, and by its having a more perfect development of inflorescence, viz. the regular calycine Perigonium found in Urticaceæ proper, whilst in the numerous utriculi of its fruit, aggregated on a common receptacle, it agrees with the Moreæ. Hyalisma and Aphylleia being very minute plants, there are one or two points which are not mentioned in the description, but which having come under my observation, it may be as well to mention. The seeds are very minute and difficult of dissection, and the embryo is so small, that it requires to be seen under a microscope, and it is then hard to say whether the cotyledons are one or two. The radicle is slightly curved and pointed towards the hilum. The albumen, which is originally liquid, becomes hard as the seed ripens, and usually causes the testa to burst on the side opposite to the raphæ. The bracteoles arise from near the root, and are there either alternate or occasionally nearly opposite. This construction seems to occur in both Hyalisma and Aphylleia. In male flowers of Hyalisma I have seen one anther burst, whilst the other three were unexpanded: this is interesting, as proving that they are not two stamina with the cells disjoined, as occurs in the American Triuraceæ, upon which Dr. Gardner has written an excellent paper, entitled 'Description of Peltophyllum,' and which in aspect has some resemblance to the plants I am describing. Hyalisma has a right to be called polygamous, as in poor specimens the flowers are all male, but whenever the plant is properly in season, it is usual to find it monœcious, with the female flowers below and the male above, and it is generally when the first scape has withered and the second is in flower, that male flowers alone are produced.

In Aphylleia the flowers are all hermaphrodite; when first blown, the stamina are conspicuous and the ovaries minute; the lateral style is at this period best seen. As soon as

the stamina are withered they are nearly obliterated by the growth of the ovaries, and the styles are so compressed by the same cause as to appear like a point between the ovaries, showing only the multifid stigma. The utriculi of Aphylleia remain much longer on their receptacle, without bursting, than those of Hyalisma; they dry without bursting, whereas if the fruit of Hyalisma is nearly ripe, the utriculi always open upon being dried. Having found specimens of Aphylleia in which all the flowers bore fruit, I feel pretty certain that I am right in considering it to be an hermaphrodite genus. The stamina of Aphylleia entirely disappear when the fruit is ripe. With respect to the structure of the stem of Hyalisma, it consists of cellular tissue without pith or concentric zones, and the skin is so slight that the stem is perfectly hyaline and the cells are distinctly visible with a small magnifying power: they are elongate and occasionally contain raphides. This cellular structure is to be expected in such a minute herbaceous plant. Having had abundance of opportunity of seeing these plants, in their different stages, I am certain that at no season of the year is a stem developed bearing leaves; the plants always consist of scapes which wither after fructification. Neither are they parasitic plants, but are found in rather moist soils in hilly places, under the shade of trees.

HYALISMA. Genus Novum.

(Plate IV.)

Flores monoici—*Perigonium* 8-partitum, lobis divergentibus—FL. MASC. *Stamina* 4, laciniis perigonii alternis adnata et opposita: *filamenta* brevia: *antheræ* peltatæ bilamellatæ, lamellis toto ambitu solutis apertæ. *Ovarii* rudimentum nullum—FL. FÆM. *Stamina* nulla. *Ovaria* plurima, receptaculo sub-convexo imposita. *Stylus* lateralis, obliquus, linearis: *stigmate* acuto. *Utriculi* plurimi, basi verticaliter

dehiscentes, membranacei, glandulis pillucidis tecti. *Semen* nudum, ovoideum basi apiculatum: *testa* dura, fragilis, reticulata: *raphæ* notata. *Embryo* inter albumen minimus: *radicula* hilo proxima.

Herba *pusilla, Ceylanica,* 6-8 *pollicaris aphylla, tenerrima, hyalina:* scapo *erecto spiciformi, sæpius dichotomo:* floribus *minutis, purpurascentibus.*

1. HYALISMA *Janthina, Champion.*

HAB.—Near Galle, Ceylon. Flowers in December to April.

DESCR.—A minute *annual* plant, throwing out a mass of fibres from a root deeply seated in the earth, and after that a flowering scape which withers after fructification and is succeeded by a second scape; frequently having the two scapes together. Leafless and not lactescent; the scape furnished with alternate ovate bracteoles; the flowers spiked and in verticels of two to three flowers together, subumbellate; pedicels longish and bracted at base. *Scape* angled; bracteoles and bracts about a line long. *Flowers* minute, about a line to a line and a quarter in diameter; the lower usually female, the upper male; and in poor specimens, the flowers are occasionally all male. *Limb* of the Perigonium purple, patent, divided into 8-linear ovate segments.

Male flowers.—Stamina 4, opposite the alternate segments of the perigonium and attached to them by the filament: *anthers* large, peltate, whitish; when young somewhat 4-lobed, but when bursting spuriously 2-celled, and open their whole extent: *pollen* spherical. *Disk* fleshy and extending between the anthers. *Sterile ovary* none.

Female flowers.—Ovaries very numerous, seated on a convex disk, purplish and covered with pellucid glands, obovoid: *style* lateral, half as long again as the ovary, attached to its base, linear persistent: *stigma* pointed. *Fruit* the enlarged ovary, at length bursting from bottom to top and showing a naked seed. *Testa* hard, brittle, reticulated, one of the sides indurated by a prominent raphæ. *Embryo*

minute, lying next to the hilum at the apex of somewhat corneous albumen: *radicle* conical and somewhat curved.

Aphylleia. *Genus novum.*

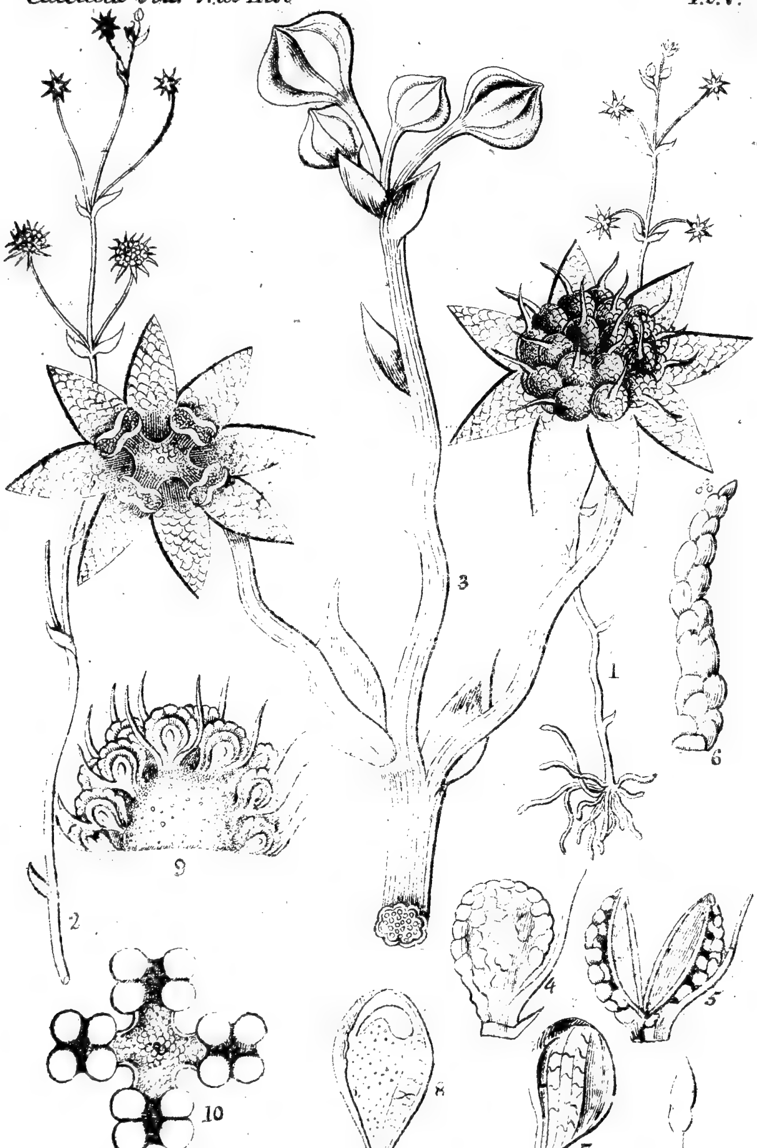
Flores hermaphroditi: *Perigonium* 6-partitum, lobis reflexis. *Stamina* 6, laciniis perigonii adnata et opposita: *Filamenta* brevissima: *antheræ* peltatæ bilamellatæ, lamellis toto ambitu solutis apertæ. *Ovaria* plurima receptaculo subconvexo imposita. *Stylus* lateralis, obliquus: *stigma* peltatum, radiatim multifidum. *Utriculi* plurimi basi verticaliter dehiscentes, membranacei, glandulis pellucidis tecti. *Semen* ovoideum: *testa* dura, fragilis: *raphæ* notata. *Embryo* inter albumen minimus: *radicula* hilo proxima.

Herba *pusilla, Ceylanica,* 3-4 *pollicaris aphylla, tenerrima:* scapo *erecto tereti, spiciformi, simplici vel dichotomo:* floribus *minutis erubescentibus.*

1. Aphylleia *erubescens, Champion.*

Hab.—Near Galle, Ceylon; in damp woods. Flowers from December to April.

Descr.—A minute *annual* plant, with the root fibrous and bearing either one or two scapes, which are only three or four inches high and several flowered. Leafless and not lactescent, the scape furnished with several alternate and minute bracteoles. *Pedicels* moderate, arranged alternately on the scape and bracted at base. The *flowers* nodding, minute, from $\frac{1}{2}$ to $\frac{3}{4}$ of a line in diameter, with the limb 6-cleft. *Segments* of the *limb* subulate, reflexed when in fructification, persistent, purplish coloured. *Stamina* six, opposite the segments of the perigonium: *anthers* when young bilobate, when the pollen bursts opening right across, white. *Style* linear, lateral. *Stigma* peltate, black, radiately cleft. *Ovaries* and *utriculi* ovoid, sanguineous red and covered with pellucid glands. *Utriculi* burst-



Hyalisma Janthina, Champion

ing from the base upwards : *seed* solitary, hard striated, marked by an elevated raphæ, naked. *Embryo* with the radicle next the hilum at the apex of rather hard albumen. *Bracteoles* ovate, half a line long.

GALLE : *June* 1*st*, 1846.

EXPLANATION OF PLATE, No V.

HYALISMA JANTHINA.

1. A specimen with male flowers only, showing the root.
2. A specimen with both male and female flowers.
3. Part of a flower much magnified.
4. An utriculus much magnified.
5. Ditto ditto burst.
6. A style much magnified.
7. A seed magnified.
8. Ditto ditto section showing the embryo.
9. Section of the fruit much magnified.
10. Anthers of a male flower previous to their bursting, also much magnified.

Description of the Wild Ass and Wolf of Tibet, with Illustrations. By B. H. HODGSON, *Esq.*

EQUIDÆ.

Genus EQUUS.—*Sub-genus* ASINUS.

Asinus polyodon mihi. *Kiang* of the Tibetans.

Sp. Ch. Wild ass with two extra molars in the upper jaw, in front of the usual series. Summer coat close and shining ; above clear antelopine-red ; below, with the entire limbs and muzzle, flavescent-white. Mane, tuft of tail, and a dorsal line connecting them, brown-black. No trace of a cross on the shoulders. Winter coat rough and frizzled, like camel's hair, and the rufous hue of the upper parts deeply embrowned. This exceedingly wild, shy, fleet, and handsome species in-

habits the plains of Tibet, in herds of moderate size, composed of females and juniors, with seldom above one mature male, and oftener none, except in the breeding season. It is very common in all parts of Tibet: but the Tibetans are wholly unable to take it alive, though it is in high esteem amongst them for its beauty and fleetness. In size and proportions it bears a close resemblance to the Tânghan or Tibetan pony, but it is rather longer in the body, and does not stand quite so high on the legs, the bones of which are sensibly shorter. The head is thicker and weightier but not longer, the size is fully as large, the forehead is more arched: the ears are longer, being scarcely inferior in length to those of the tame ass: the limbs finer and deer-like, with longer laxer pasterns, and narrower, ovoid, hard, black hoofs: the tail is asinine, that is, nude with a terminal tuft of long elastic straight hair, which exceeds the true tail by above a foot and a half: the forelock and mane are sufficiently ample, the hair of the former being five inches, and that of the latter six inches in length: the mane is partially erect, and partly droops over the neck, and both forelock and mane are considerably frizzled, or crisp and curly: the limbs have the usual callositics.

The coat of the Kiang is close and glossy, as that of a well-groomed horse, in summer, but in winter it becomes longer, rougher, and curled, like the coat of a camel. The colour of the upper parts is in summer bright antelopine-red, but in winter this bright-ruddy hue is merged in brown. At all seasons, the inferior parts, including the lower part of the flanks, the posterior part of the buttocks, the entire limbs, the lining of the ears and the muzzle, are flavescent-white. And the mane, tuft of the tail, and a dorsal line connecting them, are always black-brown. So also are the tips of the ears outside. The hoofs are black, and the iris of the eyes bluish-grey; and lastly, there is no trace (in the five skins now in my possession) of the asinine 'cross,' though the

animal possesses most of the essential characters of that sub-genus. The scull, as compared with that of the horse and mule, (I have no ass' scull wherewith to compare it) offers some striking peculiarities. In the first place, the dental formula is anomalous, exhibiting two extra molars which are small, ovoid, simple, and placed in front of the usual series.

In the Kiang the dental formula is as follows: $\frac{6}{6}\ \frac{1.1}{1.1}\ \frac{7.7}{6.6}$ Total 42.

In the Kiang moreover, the scull is more massive and weighty, exhibiting throughout more height as well as breadth, and its superior and inferior outlines are much less rectilinear; the rami of the lower jaw being much bent *up* towards the junction of the incisors, and the frontal and nasal bones being nearly as much bent *down*. The condyles of the lower jaw are less elevated, and the ascent to them from the posteal part of the rami is by straighter lines. The nasal, maxillary, malar, frontal, and parietal bones, have greater development; so that the senses, as well as the intelligence of the Kiang, ought to be quicker than those of the horse or mule. The encephalon is decidedly more capacious, and so is the nasal cavity in the Kiang. The frontals, both lengthwise and across, are more arched. And the nasals have a longitudinal groove along the mesial line. The zygomatic arches are shorter and differently curved: the orbits are fully as large or larger. The great foramen and its condyles are carried less far backwards, so that instead of forming the most posteal part of the scull (as in the horse and mule), they fall considerably within the perpendicular of the transverse or occipital crista. The incisors of both jaws are nearly erect in the Kiang, instead of sloping forwards or outwards as in the horse and mule; and lastly, the scull of the Kiang is much more suddenly attenuated towards the front or base of the incisors, where the breadth of the scull does not exceed that of the horse's scull.

Dimensions of a male and female Kiang, and of a Tânghan or Tibetan pony:

	Kiang. Male.		Kiang. Female.		Tanghan. Male.	
Muzzle to anus, ...	6	6	6	2	6	6
Tail, minus tuft, ...	1	1	1	0	1	1
Tail, with tuft, ...	2	9	2	6	3	1
Head, length of, ...	1	$8\frac{1}{2}$	1	8	1	$8\frac{1}{2}$
Ditto, extreme depth, ...	0	11	0	11	0	$10\frac{1}{2}$
Ditto, extreme width, ...	0	$8\frac{1}{4}$	0	8	0	8
Ears, length of, ...	0	$7\frac{3}{4}$	0	$7\frac{1}{2}$	0	$6\frac{1}{2}$
Height at shoulder, ...	3	9	3	5	4	1
Fore-leg, top of cannon-bone to point of hoof, ..	1	$3\frac{1}{4}$	1	$2\frac{1}{2}$	1	$3\frac{1}{2}$
Hind-leg, ditto ditto, ...	1	$4\frac{3}{4}$	1	4	1	6
Fore-hoof, length, ...	0	$4\frac{1}{2}$	0	4	0	$4\frac{1}{4}$
——— width, ...	0	$3\frac{1}{2}$	0	$2\frac{5}{8}$	0	$3\frac{3}{4}$
Hind-hoof, length, ...	0	4	0	$3\frac{5}{8}$	0	$4\frac{1}{2}$
——— width, ...	0	3	0	$2\frac{1}{2}$	less	4

	Sculls. Female Kiang.		Sculls. Male Tânghan.	
Length, from base of incisors to condyles of foram. mag.	1	$5\frac{3}{4}$	1	6
Ditto, from ditto to most salient point of occipital crest, ...	1	6	1	$5\frac{1}{4}$
Breadth (greatest), between extreme expanse of zygom. arches, ...	0	8	0	$7\frac{1}{2}$
Breadth (least), between nearest margins of orbits, ...	0	$5\frac{5}{8}$	0	$4\frac{7}{8}$
Breadth of encephalon between temporals,	0	$3\frac{3}{4}$	0	$3\frac{1}{2}$
Greatest depth or height, ...	0	$10\frac{1}{4}$	1	$10\frac{1}{4}$
Base of incisors to fore-angle of orbits, ..	0	10	0	$9\frac{1}{2}$
Fore-edge of orbit to most posteal part of scull, ...	0	8	0	$8\frac{1}{2}$
Diameter of orbit, ...	0	$2\frac{3}{8}$	0	$2\frac{3}{8}$
Greatest breadth between outer margins of upper molar teeth, ...	0	$4\frac{1}{4}$	0	$4\frac{3}{8}$
Ditto between ditto of lower molars, ..	0	$3\frac{3}{8}$	0	$3\frac{1}{2}$
Interval between nearest incisor and molar upper jaw, ...	0	$3\frac{1}{4}$	0	$3\frac{1}{2}$
Ditto ditto lower jaw, ...	0	$2\frac{3}{4}$	0	$3\frac{1}{2}$
Teeth, ...	$\frac{6.}{6.}\ \frac{1.1}{1.1}$	$\frac{7.7}{6.6}$	$\frac{6.}{6.}\ \frac{1.1}{1.1}$	$\frac{6.6}{6.6}$

Remarks.—I possess five skins procured through the kind arrangements of Dr. Campbell in my favour. I have studied with attention what travellers and systematists say about the wild horses and asses of Tibet and its vicinity; but I find little satisfactory or even intelligible beyond Pallas' account of the Dziggatai, and to that I can only refer at second-hand. There is, I believe, no species of wild horse in Tibet, and only one species of wild ass, viz. the Kiang above described, and which appears much to resemble the Dziggatai, as described by Pennant after Pallas. The Dziggatai, however, is expressly stated to *want* two of the usual complement of equine teeth, whereas the Kiang unquestionably possesses two in *excess* of that complement. Moreover, the Dziggatai is stated to have a *flat* forehead; and the colours of its mane, tail, and body differ materially from those of the Kiang. Wherefore, I think the Kiang may prove a new species, and I have named it *Polyodon,* from its singularly anomalous dentition, having 7.7 molars in the upper jaw.

Colonel H. Smith alleges that the Kiang is the prototype of the piebald race of Tânghans, a mistake which can only be accounted for by a love of paradox and want of information on his part of all but the name of the Kiang. The Kiang possesses every mark of the sub-genus Asinus, as defined *by himself,* whereas the 'Ablac' breed of ponies, peculiar to Bootan, are horses every inch of them, differing entirely, even in colour, from the Kiang.

P.S.—Since the above was written, I have received two more specimens of the Kiang, provided with sculls, and both of these fresh sculls exhibit the 7th molar tooth in the upper jaws. There can be no longer question therefore that this excess is normal. Pallas cannot have been mistaken in regard to the dentition of the Dziggatai. His total of its teeth is 38, and, as the front and binary teeth are not apt to vary like the molars, the Dziggatai's dental formula must be $\frac{6}{6}\quad\frac{1.1}{1.1}\quad\frac{5.5}{6.6}$.

CANIDÆ.

Genus Canis.—*Sub-genus* Lupus.

Lupus Laniger mihi. The *Chángú* of the Tibetans. *Hab.* Tibet.

Sp. Ch. Wolf, with long, sharp face, elevated brows, broad head, large pointed ears, thick woolly pilage, and very full brush of medial length. Above dull earthy-brown; below, with the entire face and limbs, yellowish-white. No marks on the limbs. Tail concolorous with the body, that is, brown above and yellowish below, and no dark tip. Length four feet. Height two and a half feet.

This animal is common all over Tibet, and is a terrible depredator among the flocks. The great Bhotia mastiff is chiefly employed to guard against it. It has the general form of the European wolf; but its colour is very different, and it has more elevated brows, larger ears, and a much fuller brush. Its pilage is also dissimilar and unique. From this last circumstance I derive its specific name, having no doubt that it is a new species. The Chángú has a long, sharp face, with the muzzle or nude space round the nostrils prolonged considerably beyond the teeth, and furnished with an unusually large lateral process, by which the nostrils are much over-shadowed sideways, and nearly closed. The eye is small, and placed nearer to the ear than to the nose; the brows are considerably elevated by the large size of the frontal sinuses; the ears are large, and gradually tapered to a point from their broad bases, and they have the ordinary fissure towards their posteal base; the head is broad; the teeth large and strong; the body long and lank; the limbs elevated and very powerful; the brush extends to half-way between the mid flexure (os calcis) of the hind limbs and their pads, and is as full as that of a fox. The fur or pilage is remarkable for its extreme woolliness, the hairy piles being few and sparely scattered amongst the woolliness which are most abundant. The head as far as the ears, the ears

and the limbs, are clad in close ordinary hair; the belly is thinly covered with longer hairs: but all the rest of the animal is clothed in a thick sheep-like coat, which is most abundant on the neck, above and below. The longest piles (those of the neck) are above four inches in length: those of the body generally three inches to three and a half, and those of the brush the same. The woolly piles are half an inch to an inch shorter than the hairy ones. The longer hairy piles are fine and elastic as those of a delicate man or a woman. On the back many of them are entirely black: others have large black points, then a pale central ring; and lastly, a dusky basal one: others again have a dusky basal ring, then a very large pale one (flavescent-white), and a small black terminal one, which last gradually disappears as you descend the flanks, till on the lower surface the hairs become entirely white. The woolly piles on the superior surface are almost wholly brown, passing to yellowish-white as you descend the flanks to the belly, on which last part there are no piles of this sort. The ample brush has no dark tip, as in most other wolves, but is throughout concolorous with the body; the greatest portion however showing the prevalent earthy-brown of the back. The entire face and limbs are pale and unmarked. The outsides of the ears show a ruddier tint than is observable anywhere else, and these ruddy hairs are tipt with black. The general effect as to colour is, that the animal is dull earthy-brown above; yellowish-white below, and on the face and limbs. The following are the dimensions of an old *female*, procured with the scull complete:

	Ft.	*In.*
Snout to anus, ...	3	9
Height at shoulder, ...	2	4
Tail and hair, ...	1	7
Tail only, ...	1	4
Head, length of, ...	0	11
——, width of, ...	0	$5\frac{3}{4}$
——, height of, ...	0	$4\frac{3}{4}$
Snout to fore-angle of eye, ...	0	5
Thence to base of ear, ...	0	$4\frac{1}{4}$
Ears, length of, ...	0	$4\frac{3}{4}$

Dimensions of the scull (fæm).

	Ft.	In.
Extreme length, ...	0	$9\frac{1}{2}$
——— width, ...	0	$5\frac{1}{4}$
——— height, ...	0	$4\frac{1}{4}$
Greatest interval between upper molar teeth, ..	0	$3\frac{1}{8}$
Ditto lower jaw, ...	0	2
Symp. interm. to posteal edge of last molar, ..	0	$4\frac{3}{4}$
Ditto ditto lower jaw, ...	0	$4\frac{3}{4}$
Symp. interm. to fore-edge of orbits, ...	0	$4\frac{1}{4}$

Remarks.—To Dr. Campbell's kind arrangements I am indebted for a fine specimen of the wolf of Tibet, with the scull complete. It was a female and aged, as is proved by the obliteration of the sutures of the scull and by the worn state of the teeth. Eight teats only are traceable. No European, Asiatic, or American wolf that I am acquainted with, has the frontal sinuses so amply developed on the brows, consequently, so elevated as this species, whose scull bears a great resemblance to that of the Cábúl greyhound. Notwithstanding the size of the longitudinal and transverse cristæ, the walls of the encephalon have a considerable swell, leaving ample space for a good-sized brain; and the elongation of the face, that is so noticeable in the head with its integuments, is by no means equally striking in the nude scull, so that a good deal of it must be ascribed to ample development of the cartilaginous part of the nose, a feature which, added to the unusual size of the frontal sinuses, would seem to indicate considerable powers of scent in the living animal. There are no wolves in the Sub-Himalayas. In the plains of India, as of Tibet, they abound: but the species proper to the plains of India is very different from that proper to the plains of Tibet above described. Throughout India and its vicinity, wolves appear absolutely to eschew the mountains, and so also, generally speaking, do jackals and foxes.* These

* Pearson's vulpes montanus, confined to the vicinity of the snows, is an exception rather proving than disproving the rule. It is commoner in the plains of Tibet than in the Himalaya.

wild Caninæ are represented in the mountains by the so called wild dogs, not feral Pariars, which exist only in the imagination of H. Smith, but Búánsús or Dhóls, of which our *Cyon primevus* is the type. H. Smith's definition of this type, which he calls *Chrysæus*, is many months posterior to mine, and is likewise inaccurate. The true marks of the type are the deficient molars and the excessive number of the teats. In regard to the former point some doubts have been raised; wherefore I beg leave to state, that I have examined at least thirty sculls of the Búánsú of all ages, from four months to twice as many years, without finding the least variation; that Dr. Bramley assisted me in the examination of several of these sculls, reluctantly, but fully satisfying his scepticism by means of laying bare the supposed site of the wanting tooth; and that I have similarly examined very many sculls of Pariars, sporting dogs, jackals and foxes, and yet never found a trace of that variability in the canine dental formula, which has been alleged in order to prove the Búánsú's dentition an accidental or trivial circumstance. In the present paper I have brought to light an anomaly in equine dentition. Will this also be denied or declared to be an unimportant and casual vagary of nature? Truly, if osteology may not be trusted in our science, I wonder what may be, though I need not be told, that even osteology has its anomalies.

Darjeeling: November, 1846.

Observations on the medical effects of a partial Obstruction of the Circulation. *By* THOMAS A. WISE, M. D.

The frequency and general danger of the diseases of tropical countries, and the rapidity with which they advance in their course, often reduce the system to such a state of debility, as to prevent the employment of remedies with sufficient celerity to ensure the desired effects; and even when

this is accomplished, and the patients life saved, his constitution is often so greatly enfeebled by the means adopted, as to render him afterwards enervated and more subject to disease than before. The following pages are descriptive of an attempt to remedy such a result, by means of a plan of treatment, which I have no hesitation in stating will be found both simple and efficacious.

A large class of fevers, the fatal cholera, certain local inflammations, and various other diseases of tropical countries are produced, or very much modified, by morbid changes in the circulation or internal congestions. By stopping the passage of blood in the part, or in one or more extremities, the circulation will be retarded, so as to modify its action on the diseased part, or blood in the system will be accumulated in the internal organs, as it passes through a diminished circle. The unequal and morbid distribution of blood in the internal organs which occurs in intermittent fevers, cholera, &c., is counteracted, and by this means a new and powerful action is produced, diminishing internal congestions, and modifying, if it does not check the disease, by hastening the warm stage under more favourable auspices.

I was led to this train of thought by the perusal of a fragment of a pamphlet entitled "Observations on the medical effect of compression by the tourniquet in cases of agues;" which I found bound up with an old volume of Medical Essays. It is without the title page, and although in the form of two letters, there is unfortunately no signature appended to them. I have likewise noticed, that in some cases the same method has been adopted by the Hindoos for removing pain. In one case, a native subject to colic (sool) and fever from indigestion, was in the habit of applying a ligature tightly round his arms and legs from the axillas and groins, to the wrists and ankles. In that state he lay down, and in a few minutes the pain and feverishness disappeared. In other cases of rheumatism of the head or extre-

mities the natives tie a ligature round the affected part with the effect of removing the pain. A second useful application of pressure is to increase absorption in swelled parts. The following is an example of such an application which I insert here, as it may be often used with advantage for the cure of those swellings which constitute the disease called elephantiasis.

Mirza Hyder Buksh had been for many years afflicted with an enormous enlargement of the scrotum, which he had reduced by means of pressure. The swelling was still of the size of a man's head; which, however, he attributed to the fever which he had had the night previous. Before applying the bandages he rubbed a small portion of a slightly irritating ointment over the enlarged scrotum, and the swelling was supported by a towel, the two corners of which were tied on each side, to a broad belt which had been tied round his waist. Pieces of flannel were next placed so as to prevent friction, and at the same time exclude the extremities of the penis. A long piece of broad tape encircled the swelling, and was applied tight from above downwards. So rapid was the effect of the pressure upon the swelling, that the bandage became loose, and required to be made tight twice or thrice during the day. By a continuance of this pressure the swelling was soon reduced, and with a little care and attention the cure was rendered permanent.

The intention of the following remarks is to exhibit the most advantageous manner in which a partial obstruction of the circulation may be employed in the cure of certain diseases. For convenience, I shall arrange them under different heads, with reference to the application of the treatment to accidental, symptomatic, and specific diseases.

Section I.

Accidental Congestions in which the tourniquets may be employed.

The movements and the local determinations of blood in parts are regulated by forces in the capillary vessels, independent of the action of the heart, which exercise an important influence on nutrition, and on the secretions in the part as well as its sympathies with other organs. This local congestion, or loss of balance in the circulation, sometimes occurs at particular periods of life, and in different parts and classes of vessels, and under various states of health and disease. The acute form of congestions is produced by a certain degree of stimulus to the vessels of the part, from the influence of the cause upon the nerves, or their connection with the part affected. This cause may be mental emotions, which affect particular organs or parts, through the nervous system; as in blushing, &c. This form of congestion is attended with unfavourable effects when the organ is important, or the disease severe; when it produces symptomatic fever, and an increased secretion in the part, or hæmorrhage; and in some cases, when it obstructs the function of the brain and other organs.

The treatment of congestions will depend upon their cause, their degree, and particularly their nature. When the disease is superficial, the rapidity with which the blood returns to the part, in a state of congestion, indicates its degree of acuteness. This is found to exist in every degree, until we arrive at the state of inflammation. Such variations necessarily require a corresponding modification in the remedies employed for the removal of all disease, or if the constitution is strong and healthy, the congestion will yield to the natural powers of the system; but under less favourable circumstances, it will require medicine for its removal.

One of the remedies usually employed is topical bleeding, which, by relieving the vessels of their contents, gives them an opportunity to contract; and by the reaction, to return to their natural state. In like manner blisters act by relieving the distention of blood, and stimulating the weak vessels to action, but a much more simple and certain remedy, in these cases, is the application of a ligature, so as to retard or stop the circulation in the limb in which the morbid circulation exists, and thus introduce a new action in the part. This may likewise be effected in some internal diseases by stopping the circulation in one or two limbs, which throws more blood into the trunk, and thus removes the topical congestion.

The following experiment was made upon a strong, healthy, young man, to ascertain the effect of obstructing the circulation in health; when the temperature of the air was 85°, the pulse at the wrist 80°, and the temperature of the body 98°. The tourniquets were applied to the thigh and to the opposite arm; and in a few minutes the limbs became cold and numb, but soft and flexible. The temperature of the hand on the side to which the ligature was applied fell to 93°, and in the axilla beyond the ligature to 97°. The other parts of the body after the ligature was applied appeared much warmer than before, and a perspiration covered the skin; pulse 88°, while the temperature of the axilla was 102°. In five minutes after the ligature had been applied to the limb, the heat of the surface and pulse of the remainder of the body increased in velocity by twenty beats in a minute, so as sometimes to cause a flushing of the face, anxiety, and frequent respirations. In six minutes the obstruction of the circulation induced a tendency to syncope as in a plethoric person. Immediately on the removal of the obstruction, these symptoms disappeared, and the pulse fell below its natural standard: and in an hour after, it is often ten beats slower than it was previous to the application. Thus the effect of obstructing the circula-

tion is to increase the momentum and velocity of the blood; which being arrested in its passage, little blood is left in the limbs. The morbid internal distribution of the circulation is thus arrested, internal congestions are disturbed, and eventually removed, by the increased quantity of blood which now circulates with greater velocity through the parts not compressed, and a mild warmth is produced, followed by a retardation of the circulation. By this means morbid actions may be modified, and eventually checked.

By employing a field tourniquet, and producing a less degree of pressure, the arteries may be allowed to convey blood to the limb, while the return is more effectually barred by the pressure of the ligature upon the more superficial veins; by which means the internal morbid circulation is relieved, and much more blood is retained in the limbs than before. Thus great relief is obtained in many internal diseases, more particularly of the head and chest, by this sudden abstraction of so much blood from the circulation. I shall only mention cases of apoplexy, hæmoptysis, tetanus, &c. as examples of disease in which this mechanical remedy may be employed with great advantage.

A therapeutical agent of such power, and so easily managed, will be of great use in removing many diseases in the large and important class of symptomatic congestions, which I shall next consider.

Section II.

Symptomatic Congestions.

A certain degree of local irritation produces a determination of blood to various organs, and often occasions formidable functional disorders. As this state is peculiarly under the salutary influence of medicine, it is of very great importance to distinguish it; and to use the proper means of correcting

it, as such congestions will pass on to inflammation, and lay the foundation of some of the most fatal diseases. The lungs, brain, liver, and spleen, the tegumentary tissues, and sometimes the serous membranes are liable to be so affected, and in all such diseases there is sooner or later so great an accumulation of blood in the parts affected, as to produce considerable disturbance in the functions of the part, and to require prompt and careful treatment for their removal.

Whatever debilitates the tonic powers of vessels, renders them more susceptible of the influence of malaria, which produces congestions of organs. Such causes are—a residence in unhealthy climates and situations; living on poor food; great fatigue; long watching; grief; exposure to cold; sleeping in damp rooms or beds; the use of some medicines, as mercury, by first increasing irritability, is followed by great weakness of the system, in which state congestions are liable to occur. The fever developes itself on exposure to cold, while the system is under its influence, producing a congestion in one or more organs, which become oppressed, while there is at the same time a diminution of vital power, or the cold stage of fever is produced.

These congestions frequently take on an intermittent form from the peculiar state of the vessels of the part. The symptoms recur in paroxysms until the vessels return, by reaction, to their natural condition. Persons once attacked are very susceptible of relapse from very slight causes, which favour the recurrence of the internal venous congestions.

The premonitory, or forming stage of fever, includes the period intervening between the first deviation from health, from the injurious impressions of inanimate or other causes of fever, and the commencement of a febrile paroxysm. This important latent period is not always very definite. Most patients first feel languid and tired with loss of appetite; they complain of slight head-ache, and aching pains in the loins and bones of the limbs. This state lasts from one to ten days,

and a paroxysm of the symptoms occurs about noon, and terminates in a rigor, which proves the commencement of the paroxysm of fever. This first attack assumes the type, from which the other forms of intermittent fever are supposed to be derived. Should the febrile state be increased twice a day, so that a fresh attack occurs before the previous attack had subsided, it forms the remittent fever; from which the remaining continued type is deduced in which the remission becomes gradually less distinct. This continued, or more severe form of fever, as it diminishes in violence, has a tendency to take a regular or an irregular form, and at last intermissions occur. These remarks regarding the nature of fever evince the propriety of varying the treatment to be followed, and by observing the premonitory symptoms, the physician by the judicious employment of remedies, will be enabled to render the disease milder and less dangerous; whether it arise from the impression of cold, or from a contagious source. In both cases the first symptoms that declare themselves are much the same, and they will pass through their course varied under different circumstances, unless these symptoms are checked, or the fever cut short. This has been attempted to be done by the violent action of medicine, such as a full dose of tartar emetic, the sudden shock of the cold affusion or a large bleeding, so as to enable the constitution to throw off the disease; but these methods are now considered dangerous, and are very rarely had recourse to.

The first symptoms observed of an attack of ague are a feeling of langour, a sense of debility and sluggishness, in some cases nausea, and vomiting of bilious matter, an aversion to food, and a diminution of the secretions. The face of the patient becomes pale, the features and external parts shrink, and the skin becomes constricted. The person feels very cold; rigors come on, with pain in the back, head, loins, and joints; the sensibility is impaired, the thoughts confused; the pulse is small, frequent, and often irregular; and the

respiration short, frequent, and anxious. In some few cases drowsiness and stupor have prevailed in so high a degree as to resemble coma or apoplexy.

This cold stage is succeeded by the hot stage which is ushered in by a decline of the above symptoms, followed by an increase of heat over the whole body, and this is, in its turn, succeeded by perspiration, or the sweating stage.

In different individuals a considerable variation may be observed, both in the severity of these symptoms, and in the mode of succession, and the stages may be in different proportions of duration to each other. In some cases such a prostration of strength takes place as to endanger the life of the patient. In general however the disease is rarely fatal when the interval between two paroxysms is distinct and of considerable length. But even in these cases the person becomes weakened by the repeated paroxysms, which occasion a loss of appetite, flatulency, and other symptoms of indigestion, enlargement of the spleen, and its distressing consequences, and of the liver, followed by dropsy, and general debility. Such attacks of fever may terminate in chronic organic diseases, though in some instances the fever changes from the intermittent to the remittent and continuous forms, which often prove fatal, unless the patient removes to a more salubrious climate. It is therefore of the greatest importance to cut short the ague as soon as possible.

The usual directions given for the treatment of ague are empirical and uncertain; and the disease is so very distressing in tropical climates as to deserve a careful consideration. The stoppage of the circulation in one or more limbs is the most simple, yet at the same time a powerful therapeutical agent in the case of intermittent fevers, and forms a striking contrast to the usual feeble and ineffectual method of the application of warm clothes, heat, and internal stimulants. These, it is true, diminish the distressing feeling of cold, and

hasten the accession of the warm stage, but are much less effectual than the plan of obstructing the circulation. Dr. Macintosh, of Edinburgh, recommended blood-letting in the cold stage, on the principle of diminishing its duration, and hastening on the hot stage, while at the same time its violence is decreased. This effect it produced, by lessening the mass of the blood, and dispersing morbid local congestions. The same method was energetically employed by the late Dr. Twining, who proved that such a loss of blood had the effect of favourably modifying, and even of checking intermittent fevers. But it had the great disadvantage of weakening the system ; and thus increasing the tendency to relapse, an event so common, as in many cases to render it necessary for the patients to proceed to a more congenial climate, in order to restore the vigour of the constitution. The general results of the numerous cases in which I have stopped the circulation for the cure of ague were, that when the tourniquet was applied to one of the extremities, previous to the accession of the paroxysm of ague, known by the premonitory symptoms, the cold stage was entirely prevented, and a slight attack of synocha followed ; and that when applied at any time during the cold fit of an ague, in two or three minutes after, a modified warm stage was induced, which was rendered milder and shorter in its duration, and more easily brought under the influence of medicine ; and when the attack was accompanied with pain in the back or headache, these symptoms were speedily removed. The following cases are given as favourable examples of the usual effects of the tourniquet in cases of simple ague.

Case I.—Bisto Sunder Bhutacharge, aged 40, has had a quotidian fever for seven days. The tourniquet was applied on the morning of the 4th August, when he had no fever. He felt faint after it was removed, and this feeling was succeeded by

heat of the surface which went off towards evening. He had no return; and has applied to-day (13th August), at the hospital, on account of another complaint.

Case II.—The following is a case of ague in an officer in the H. E. I. Co's. army. At the latter end of July he was attacked with fever, probably from sleeping in a low, damp bungalow, from exposure to the weather, and irregularities in living. "I suffered," says the patient in his account of the disease now before me, "for three successive days from attacks of fever and ague, the fits commencing regularly at 11 o'clock A. M., on the two first days the cold fit was very slight, but fever, accompanied by severe pains in all my bones and joints, remained till evening. On the third day I experienced a severe attack of ague at the usual hour, and immediately sent to the Native Doctor to come over with the tourniquet, as recommended by you. He came in ten minutes, while I was shivering violently, and applied a tourniquet round the left thigh, and one round the right arm. They were kept on for seven minutes. The shivering ceased immediately, and was succeeded by a mild fever, without any pains in the limbs, which accompanied all my former attacks. This occurred upwards of a month ago, and since then I have not had the slightest recurrence of the complaint, although for a long time previous I had been subject to constant attacks." He continued to reside in the same house during a most unhealthy season with impunity.

Case III.—A respectable Mussulman, aged 40, residing in a country-house which was low, damp, and surrounded by jungle and tanks, was attacked with a quotidian fever, which increased in severity, and on the eleventh day it was so severe as to endanger his life. The intermission was still marked. I administered a purgative and saline mixture on

the accession, and a dose of quinine in the interval. The next day during the cold stage, the tourniquet was applied for ten minutes, and when he complained of a dizziness in his head, it was removed. The cold stage was quickly succeeded by a gentle heat, which continued during the day, and terminated in a slight perspiration.

26*th July*.—He had slept well; and his skin was warm and perspiring. He complained of thirst; his tongue was dry in the centre; pulse small, soft, and slow.

29*th*.—There has been no return of fever, and he is gradually gaining strength under the use of tonics and aperients.

25*th August*.—Quite well; had no return of fever after the first application of the tourniquet.

10*th October*.—Continues well.

The complication of intermittent fever with local affections, more particularly with enlargement of the spleen, is very common in Bengal, and renders the cure, in many cases, more difficult; and a more frequent employment of the tourniquet is required than in the simple forms of ague.

Case IV.—Sunker, aged 30, was admitted into hospital on the 13th July, in the hot stage of a tertian fever. Spleen enlarged; the tourniquet was applied for ten minutes in the cold stage of an attack. It immediately put a stop to the cold, and the hot stage which followed, was short and very mild, but was succeeded by a feverishness, which continued during the night. Bowels three times affected; next morning the skin was cool, and the pulse soft and 62.

The paroxysms were thus cut short twelve times with the same result, only that the hot stage and the fever went off towards night; and in one of these occasions, I found the pulse next morning soft, and 48. On the 3rd August he was discharged quite well, when no enlargement of the spleen could be perceived.

Case V.—Kumurudeen, a ryut, aged 20, called to-day 12th Sept., on account of a venereal disease he had contracted: having been cured of a quotidian fever by two applications of the tourniquet. When he first applied for assistance at the hospital he had an enlarged spleen, which was cured by obstructing the circulation. I afterwards carefully examined this person, but I could not feel any traces of it remaining.

In the state of fever in which the intermission is less marked, the employment of the obstruction of the circulation is not always of such advantage as in the more simple form. Still it is of very considerable use when employed during the remission; by weakening its power, and modifying, and at length removing the disease, and may be adopted as an auxiliary to the ordinary methods of treatment for curing the disease.

Attacks of ague sometimes alternate with attacks of dysentery. In such cases physicians must vary the treatment according to the urgency of the symptoms, and the patient should remove from the locality in which the disease was contracted. In many cases of this complex form of disease mercury will be found of use in removing it.

The following is the result of a case of remittent fever, which, after being treated for some days, assumed the intermittent form. I then had the tourniquet applied, and the following is the result in the patient's own words: "On the 23rd instant (August), whilst in the cold stage, I sent for one of your assistants, who immediately came and bandaged my left arm and right thigh. A change was soon felt, inasmuch as a certain degree of warmth was generated, which subsided gradually on the bandage being removed, carrying off the fever along with it. I have not had a return since, and now attend to my duties at the College."

The above patient should have stated, that he returned to his duties as teacher in the College the day after the tourniquet was applied, and had no return of fever.

When in charge of the 5th Regt. N. I., my duties as Civil Surgeon obliged me to reside at a distance from the cantonments, and being under the necessity of relying on native assistants to apply the tourniquets in my absence, I found that they frequently applied them when the hot stage had commenced, or before a complete remission had occurred, and a modified fever followed, which resembled the synocha of Cullen. In all such cases a diminution of the febrile symptoms was the consequence; which were very well marked after the tourniquet had been removed, though the fever usually continued during the night, but was rarely perceptible next morning. I never saw any bad result; the fever seemed changed in its character, the pains in the limbs and bones ceased, and cuticular heat was felt over the body which was warm and dry. In many cases the disease is effectually cured.

I have now before me the particulars of 77 cases of intermittent and remittent fevers, all of which were very much benefitted or entirely cured, by the employment of the ligature: of these—

27*	were cured by one application.
26†	by two or three applications.
19‡	by from four to six applications.
5§	by from seven to ten applications.
Total .. 77	cured by the application of the tourniquet.

Congestion of the Spleen.

The favourable effects produced on fever and its sequelæ, the congestion of the spleen, which is often so rapid in its growth and dispersion, induced me to try it in cases in which this organ was enlarged without any fever.

* 11 of these uncertain.
† 4 Uncertain.
‡ None uncertain.
§ One uncertain.

The spleen is indeed not so directly in the course of the circulation, as to cause an immediate effect upon the organ; but still, the agent employed is so powerful, that I had little doubt of its ultimate effect. I was careful to select cases in which the spleen had been recently enlarged, and with little thickening of the parenchyma of the organ. The following is the result of the experiments.

In nine cases I applied the tourniquet in cases of engorged spleen without fever. In all the cases there was benefit derived from the remedy; the spleen became softer and smaller. Two of these cases were cured by the application of the tourniquet. Three applications of the tourniquet were made in one, and four in the other case; and seven patients were in a fair way of recovery by a continuance of the treatment.

Elephantiasis.

This is a common disease in Bengal; and often recurs for many years before it acquires the great size it sometimes assumes, when it is usually known by the name of elephantiasis. In its primary form, it is called by the natives "*Ganger*" or "*Saket*;" when it is supposed by them to be produced by the influence of the energy of the water over the other corporeal elements. It commences with a feeling of indigestion, and general uneasiness; a tenderness and pain of the groin or axilla, succeeded by a feverish state, in which the skin is hot and dry. This fever has a daily exacerbation, which increases on the second and declines on the third day, and is succeeded by pain, and swelling of one of the arms, or feet and legs. The bowels are sometimes constipated, at other times relaxed. The scrotum is sometimes affected in the same way. These swellings sometimes take place at the upper part of the thigh or arm, with more pain but less swelling than when they occur in the extremities of the members. That of the arm is often in the inner side, and extends in an oblong form to half the length of the arm.

It continues the same as that of the leg, unless when it terminates in a painful hardness which suppurates. Supposing that the tourniquet might be employed with advantage by diminishing the quantity of blood sent to the limb affected, and by increasing the mass in the rest of the body, that the morbid action might thus be removed, I applied it in the following case.

Case VI.—Petumber Doss, aged 23, has his left leg twice the size of the other from elephantiasis. He had likewise a large discharge of serum from a number of pustules which had formed on the swollen part. The periodical fever was stopped by the ligature. He slept after this, and next morning was quite free from fever. Had no return of fever for a considerable time afterwards.

Ephidrosis, or Burning in the feet and hands.

This is a very common endemic complaint in the moist plains of Bengal, and attacks all ages and both sexes; but it is most common in persons engaged in sedentary employments. In the dry sandy plains of Upper Hindoostan, it is never seen. There are two varieties of the disease, the moist and the dry; the former being most commonly seen in the young, and the latter in the old.

The burning in the hands with moisture generally attacks individuals at an early age, and in some cases appears to be hereditary. In this variety, the paroxysms come on periodically, but they are produced at any time on any cause agitating the body, or accelerating the pulse. Thus I have seen a youth standing before me, and exerting himself mentally, attacked with a paroxysm of the disease so severely, that large drops of perspiration fell rapidly from the extremities of the fingers. When the part is wiped dry with a cloth, it again becomes bedewed with moisture. Before this takes place, the person feels a hot burning sensation in

the hands and feet, followed by copious perspirations, which extends to the sides, and in a less degree to the backs of the hands. The right hand appears to be more affected than the left, and these again more than the soles of the feet. This disease is more troublesome in hot than in cold weather; and when the health is impaired by any cause, particularly when the bowels are relaxed.

This disease is not only distressing in itself, but not unfrequently prevents the person affected with it from following his trade or occupation.

The dry fever of the feet occurs more frequently in the old and debilitated, who have been afflicted by disease, more particularly with fever and bowel complaints. Under such circumstances the European is not exempt from its attacks, which are of a most distressing nature, without exhibiting any appearance of inflammation or disease of any kind. It exists in very different degrees of severity; from an uneasy sensation of heat and tingling to a severe burning feel in the soles of the feet. The burning pain often becomes excruciating, and sometimes extends along the leg, which prevents sleep, and deranges the digestive organs, and the general health.

The paroxysms take on a remittent or intermittent form; and a paroxysm is liable to occur, on exposure to the exciting causes.

In these cases, the very important perspiratory function which the skin performs in tropical climates, is deranged, more particularly in the soles of the feet and palms of the hands, where the thick cuticle and the diminished force of the propelled fluid prevent such a free circulation, as in other parts of the body. When the system is deranged, such a degree of debility will be the consequence as will predispose him to the disease. Should it occur in the young, the activity of the arterial system is likely to produce copious perspirations soon after the burning feeling is experienced;

and this local discharge will be produced by any of the usual exciting causes which accelerate the circulation by which the distressing symptoms will be relieved. The second or dry variety is by far the most distressing, and from the nervous capillaries being more particularly affected, the paroxysms of burning are very severe, and extend in twitches to some distance along the limb. The exposure of the poor to vicissitudes of the weather, and the use of a meagre and indigestible diet, render them more subject to the disease than others under different circumstances.

The above remarks on the nature of the disease will enable us to understand why local remedies will not be of more than temporary use, and will explain the method of treatment which should be considered in a two-fold aspect, as palliative and curative. To the first class belong absorbent earths to allay the distressing symptoms, to arrest the perspiration with warm fomentations and anodyne oleaginous frictions, to soften the skin, to promote the circulation, and to allay the pain. The method of exposing the feet and legs to the fumes of milk sprinkled upon the leaves of mudar is often of temporary use. This should be repeated daily, when the cure is said to be rapid and complete.* A more effectual means of stopping a paroxysm will be found in arresting the circulation in the limb for a time, which will remove the distention of the capillary vessels; thus interrupting the habitual course of the disease, and enabling the practitioner to employ medicines and diet, so as to obtain a complete cure. This will, in general, be effected by a nourishing and easily digested diet, with stimuli; and the employment of an alterative course of calomel, which, in many old cases, will require to be carried to gentle ptyalism. In such cases the same nourishing food should be employed with tonics.

* See Transactions of the Medical and Physical Society of Calcutta, Vol. ii. p. 275.

The following case is given as affording a description of the usual course of this distressing disease, in the words of the patient.

CASE VII.—Callykissore Chatterjea, a large and strong youth, aged 19: states—"I have been afflicted with this complaint from my infancy, and it seems to increase as I advance in years. No member of my family has had this sickness, with the exception of my youngest sister. The intervals of the attacks are diminished, but during the cold months it is not so troublesome as it is during the rest of the year. In the hottest days, the perspiration from the palms of the hands and soles of the feet, is so copious, that I cannot employ myself in reading or writing, sometimes for a whole day. The perspiration on such occasions drops from my fingers for hours. At night, and during damp and rainy days, it is not so troublesome, nor occurs so frequently. During the hottest time of the day, I feel a burning sensation in my hands and feet. In the mornings and nights the hands and feet are of the same temperature as the other parts of the body, but as the day advances, the heat of these parts increases.

22nd June.—Compressed the humeral artery for six minutes; the veins were allowed to swell out, when the arm felt benumbed, cold, and livid.

23rd.—Compression for twenty minutes; numbness and uneasiness from the stoppage of the circulation.

24th.—Better: perspiration in the hand yesterday diminished. Again applied the tourniquet for the same time as yesterday.

8th July.—Better: the palms still perspire. Temperature of air 83°, pulse before experiment 82; after the ligature had been applied some time, the temperature of the hand of the compressed side was 88°; in the axilla beyond the ligature, 97°; in the opposite axilla, 99°.

8th Sept.—Saw this patient. He thinks the application of the tourniquet has been of much use in diminishing the perspiration in the part. A continued application would most probably have permanently cured the disease; but the young man has not patience enough to persevere.

SECTION III.

Specific diseases accompanied with congestions.

In treating of diseases produced by peculiar or specific congestions, some remarks will be offered on rheumatism and gout, cholera and exhaustion.

Congestions of blood in Rheumatism and Gout.

These diseases are of frequent occurrence, modified somewhat by the climate and other causes. Rheumatism in tropical climates is a difficult disease to treat; the symptoms being more violent, and the treatment more difficult than in temperate climates; whereas gout is only found among the luxurious in large cities, and is generally a more simple and less fatal disease than in Europe.

The most severe form of rheumatism is that which attacks particularly the periostium of long bones, and it is particularly severe at night. In many cases I could trace no connection with it and venereal disease: indeed, in some cases, there was no reason to suppose such a combination.

The effect that obstruction of the circulation produces, is to remove the severe pain in the limb beyond the ligature. The pain recurs on the removal of the obstruction; but in a modified degree, and by a repetition of the ligature, it gradually decreases, and at length entirely disappears.

Case VIII.—Gopaul Sing, aged 25, was admitted into hospital on the 3rd July, with a severe attack of rheumatism in the knee-joint. The tourniquet was applied for seven minutes, which stopped the paroxysm; next day he felt so well that he could walk about.

4th.—As the pain returned, the tourniquet was again (5th) applied for 15 minutes, when the pain ceased, and the patient could walk about: pain increased during the night, and now (6th) he complains of pain in both ankles. Again applied the tourniquet with excellent effect. A slight return of pain in the evening.

7th.—Much better; still a little pain in the ankles.

8th.—Pains slight, confined to the feet and two ankles.

26th.—Pains much decreased; still weak; now only a slight pain in the foot. 13th. Well. The ligatures in this case were of great use in removing the pain and in curing the disease.

Case IX.—Baguban Chunder Banerjea, aged 23, has been suffering for a year and a half with rheumatism, which has quite unfitted him for study, or for gaining a livelihood. It first appeared as sciatica, then it attacked the knee, and lastly both heels, where the tendo-achilles is inserted into the os-calcis. He moved about with great difficulty and pain. When at rest he had less pain. The tourniquet was applied to the right leg, which immediately removed the pain, and he could stand without uneasiness. He had painful attacks of lumbago, which were relieved by narcotics, &c. and the occasional application of the tourniquet. This certainly removed the pain, and diminished the severity of the disease.

Cholera.—The difficulty of assigning a cause for certain diseases is sufficiently evidenced by the new theories continually proposed, and new remedies recommended for their removal. In none is this better exemplified than in the fearful cholera; the attacks of which are so sudden, and the symptoms so peculiar, as to require the careful consideration

of the physician. Among these are the remarkable changes in the blood from the escape of the serous parts into the alimentary canal, and the extreme thickness of what remains in the veins; which renders its circulation extremely difficult, and produces that congestion in the heart, as well as in the head and portal system, which forms such a remarkable feature in that disease.

If the unusual determination of blood to the alimentary canal can be checked or modified, it will probably strike at the root of the disease, and this can best be done by the application of the ligatures to the extremities, by which more blood is sent into the interior. The morbid congestions are thus removed, and the painful cramps of the extremities being stopped, there is an accession of heat in the trunk which modifies the disease, and allows time for medicines to act. This theoretical notion I had soon an opportunity of testing, and the result was highly satisfactory. This is best seen by examples, of which the following are a few.

Case X.—Hunoman, aged 25, was brought into the city hospital on the 15th July, after several evacuations, which had reduced him very much. No pulse at the wrist, and severe cramps in the legs. A cholera pill, with some of the mixture, was immediately administered; hot bricks applied to the feet, and oil rubbed over the body. The tourniquet was applied for ten minutes, which immediately stopped the cramps, and improved the pulse. Pain of the abdomen at times severe with restlessness. This pain appeared not to be affected by the ligatures; the pulse however improved, and the cramps of the legs were completely and permanently removed.

18*th*.—Well: left the hospital.

Case XI.—Noor Mahomed was brought to the hospital labouring under cholera; purging and vomiting; skin cold,

and no pulse at the wrist. The tourniquet was applied to a leg and arm; a sinapism to the abdomen, and cholera mixture administered. These means produced an amelioration of all the symptoms; the purging and vomiting ceased, the heat of the body increased, and he slept most comfortably. Was well next day, and has continued to get stronger: on the 8th he was discharged quite well.

I soon saw the necessity of retaining the tourniquets permanently, leaving one free for a time, and again putting it on, so as to avert the collapse, which follows the removal of the ligature, and thus retain the increased strength, which the diminished circulation had produced. The following is the result.

Case XII.—Gunga Sing, was brought to the hospital at noon of the 23rd October, in the collapsed stage of cholera. There was very great anxiety and restlessness; no pulse at the wrist, and great thirst; no vomiting nor purging. The tourniquets were applied, and the body became warm, while the extremities remained cold.

24*th.*—The tourniquets were continued all day and night; at times they were slackened, and they have been removed some hours this morning; body warm; extremities cold and dry. The eyes continue much sunken, turned upwards, inanimate, and filled with white mucus. Very anxious and restless; pulse small and very weak after the tourniquets were applied. Temperature of the body 100°. He complained of the tourniquets, and at last removed them.

25*th.*—Still anxious and restless, with 24 respirations in a minute; in other respects better. His look much improved; eyes more animated and clearer; has appetite, and has eaten some arrow-root; but will not allow the tourniquets to be applied. They seem to irritate him, and having discovered the method of loosening them, he does so without hesitation. The circulation being left free, he rapidly got worse, although all the usual remedies were employed for cholera,

such as heat, friction with stimulants, narcotics, and calomel, &c. internally.

26th.—He died during the night.

This was the first case in which a continued application of the tourniquet was attempted, and although the result was unfavourable, it satisfied me that the tourniquet was a very valuable remedy in this most fatal disease. This seems to be proved by the following cases.

CASE XIII.—Ducus Sing, aged 30, was admitted yesterday afternoon into the city hospital, in the collapsed stage of cholera. He had vomited, and his motions were scanty and like *conjee;* body cold; pulse soft and accelerated, probably from the exertion of being brought to the hospital, but it soon became imperceptible; his eyes became sunk and lifeless. Narcotics, and the usual stimulants were employed without effect, and he continually complained of thirst. The tourniquet was applied to the arm and leg, and the pulse immediately rose, and the warmth of the body increased. It was continued, but was loosened several times by the patient; and during the night was removed altogether. Morning—cold; eyes sunk; pulse imperceptible at the wrist; thirst less. In this state when the temperature of the air was 86° and that of the axilla 96°, I applied the tourniquets, and in five minutes the pulse became full, soft, and 112° in a minute; the temperature somewhat increased; in the axilla 97°; feels better; wishes to eat.

30th.—Three white motions after ten grains of calomel and one grain of opium; secretion of urine free and well coloured. Sleeps well; pulse full; skin cold.

31st.—Four leeches applied last night to the temples; which diminished the determination to the head. The patient feels well, and wishes to go home. I have recommended him to remain two days longer.

2nd November.—Left the hospital well.

Case XIV.—Sadu Mistree, aged 30, was admitted into the hospital on the 23rd October, in the collapsed stage of cholera; pulse imperceptible; has vomited and voided white *conjee* stools. The tourniquet was applied to the arm and leg, and kept on permanently; or only removed occasionally, and applied for a time to the opposite member. Pulse 84°, small and weak; extremities cold; trunk warm; temperature of the body 98°.

25th.—Body cool; extremities cold; pulse small, weak, and 88°; *conjee*-water stools. The tourniquet has been applied, but had been at times loosened; it had been removed for two hours before I saw the patient at my morning visit. On its being again applied the pulse became more full and regular, and the warmth of the body increased; which was found to be 99° by the thermometer. The usual calomel medicines were likewise exhibited.

26th.—Improving in every respect: continue the tourniquets.

27th.—Nearly well; slept well; temperature of the body natural; secretes urine, and dejections much improved in consistence and colour. Pergat.

30th.—Weak; in other respects well.

3rd November.—Left the hospital quite well.

I do not consider it necessary to relate other cases, as the result continues much the same. I found it difficult to persuade native patients to continue the application of the tourniquets: not so much from any pain they produced, as from their feeling a degree of restraint in the member, to which the tourniquet had been applied; and when there was, at the same time, a feeling of great anxiety and restlessness, as is so often the case in this dreadful disease, they seized any opportunity of removing the ligature, which afforded almost the only

chance of eventually removing the painful state of anxiety and restlessness. They were disappointed that it did not, as they expected, immediately alleviate the more distressing symptoms. When the obstruction was allowed to continue for a short time, the tourniquet was no longer complained of; and I have seen European patients request that the tourniquet might be applied; so great was the relief which they had obtained from previous applications.

These favourable effects of the tourniquet in the cholera may be classed under the following heads:

1*st.*—Stopping immediately the most distressing cramps of the extremities.

2*nd.*—By increasing the circulating fluid in the trunk, it removes morbid congestions, prevents the morbid secretions, increases animal heat, produces new effects, and most powerfully tends to restore the patient to health.

3*rd.*—By sustaining, and in a measure restoring, the vigour of the constitution, so that medicines act more powerfully, and in a more salutary manner, in removing the remains of the morbid action.

4*th.*—When reaction takes place, by loosening one or more of the tourniquets, the local determinations to the head or heart are prevented; the quantity of blood sent to particular parts, is thus diminished. In such cases the patient must be carefully watched, and the tourniquets immediately tightened, when there is any tendency to a relapse, or any symptoms of sinking appear. I have seen the happiest effects produced which have been ultimately blasted by removing the tourniquets too early, and allowing the symptoms of cholera to form anew when its fatal course could not be arrested.

5*th.*—On this account, I have often been under the necessity of continuing the application of the tourniquets for days

together, with the happiest effects, till they could, with safety to the patient, be gradually discontinued. In all cases we must be guided by the nature of the existing symptoms. When reaction takes place speedily, it is to be promoted and kept up for sometime until a determination to any of the internal organs indicates the necessity of loosening one or more of the tourniquets, which are to be again tightened on the re-appearance of any symptoms of collapse.

Use of partially obstructing the circulation in Syncope, in apparent Drowning, and in Exhaustion.

The late Mr. Hyslop* having bled a lady to syncope, became alarmed at its long continuance, but on accidently raising her from the horizontal position by grasping her arms, and thus supporting the weight of her body, she rapidly recovered. Surprised at this, Mr. Hyslop was led to reflect what could be the cause of so sudden a restoration of the heart's action, and he became convinced, that whilst elevating the body, and allowing its weight to be supported by that part of the arms along which the brachial arteries pass, he must have compressed those vessels, the effect of which compression was an impediment to the flow of blood through these arteries, and consequently caused an accumulation of blood in the heart, from which he concluded that the rapid recovery of this patient from syncope was analogous to the artificial process of transfusion; and he proposed to adopt it in cases of syncope or apparent drowning, in order to revive the heat.

In many severe diseases, the patient after recovering from the dangerous symptoms, sinks into a state of collapse and

* See Dr. Wardsop on Diseases of the Heart. Part I., p. 18, Lond. 1839.

dies. This is frequently the case in cholera; such patients are immediately relieved by the use of the tourniquets. Frequent examples of this disease occur in the Insane Asylum of this city, and I have had opportunity of employing the powerful stimulus, of throwing more blood into the internal organs, with the happiest effects. In these unfortunate individuals, the excitement of feelings and agitation of mind conjoined often with want of rest and sleep, are not unfrequently followed by great exhaustion; particularly at the commencement of the cold season. These weak and debilitated patients first lose their appetite, and this is followed by diarrhœa, coldness of the surface, and a rapid prostration of strength. In such cases the circulation is so languid, that the pulse cannot be felt at the wrist. After repeated trials, I found that artificial heat applied to the surface, and different kinds of internal stimuli, were of little use. In some of these patients the weakness was so great, that when placed in bed they were not able to move, so as to place their limbs in a more comfortable position. The eyes become often affected with indolent ulcers, which not unfrequently terminated in sloughing of the cornea. In other cases the eyes are languid, the vision indistinct, and hearing obtuse. The skin remains cold, and is often covered with a cold clammy perspiration. The average of seven of these cases shewed the animal temperature to be 94°. There was generally a looseness, and the dejections were often evacuated involuntarily; but it did not appear to be the cause of the debilitating symptoms. It seemed rather one of the consequences, as it was sometimes not present. In such cases I found the tourniquets afforded the only remedy, and to obtain the full effect one required to be put on each extremity. The result of my experience is very favourable to this agent. The stimulus of the ad-

ditional quantity of blood directed to the internal parts was speedily evident. The animal heat was soon restored, and by keeping them on for sometime, and cautiously removing them as the symptoms indicated, a rapid reaction and restoration to the usual state of health followed. I have seen patients recover by these means in the worst cases of collapse, when the debility was so great as to prevent the action of the usual remedies.

[It would appear that the pamphlet to which Dr. Wise refers in the commencement of his very curious and interesting observations, is a paper by Dr. Kellie, which appeared in Duncan's Medical Commentaries for 1794 and 1797. Dr. Kellie informs us, that in fever if a tourniquet be applied in the cold fit on one thigh and one arm of opposite sides for two minutes, a mild hot stage is induced, and the patient feels quite relieved. When the instruments were allowed to remain on for fifteen minutes, on their removal the cold symptoms did not re-appear. He also thinks, that if the tourniquet be applied before the accession of the paroxysm, the cold stage will be entirely prevented, and that whether the cold stage be shortened or altogether prevented, the following hot stage will be rendered both milder and of shorter duration. This practice seems never to have been generally adopted, and though not condemned, as the bleeding in the cold stage of Mackintosh appears to be, by the profession, is now entirely forgotten, but it is worthy of remark, that Bailly in 1825* strongly recommended the adoption of this practice in malignant intermittent, where a recurrence of the paroxysm is much dreaded, and it seems to deserve further trial.

The remarks of Dr. Wise on elephantiasis are especially worthy of attention, as his obstruction of the circulation is analogous in its operation to methodical compression, the importance of which in the treatments of tumors is becoming daily more and more recognized in modern surgery.]—J. M. P.

* Traité des fievres intermittentes simples et pernicieuses.

Howrah Hospital Report for 1846, *containing reference also to a few cases of supposed Spinal irritation and disease treated without the Hospital. By* W. A. Green, *Esq., Bengal Medical Service.*

It is unnecessary to remark upon the generally accredited prolific causes of sickness amongst the seamen of the port, such as reckless exposure to day and night temperature, to vicissitudes of extreme heat and chilling dampness, in addition to excess in drinking, &c.

The hospital is an upper-roomed house, cheerfully situated in an open and airy position, in the vicinity of the river. The average monthly range of the thermometer, during ten months of 1846, from the 3rd March to 31st December, placed in the centre room below-stairs, out of the way of currents of air and of the sun's rays, has been as follows :—

	Aver. Temp. 8 A. M.		Aver. Temp. 3 P. M.
March,	79.14		85.50
April,	84.10		89·50
May,	85.32		88.64
June,	84.06		85.74
July,	83.40		84.80
August,	83.32		84.64
September,	83.13		84.43
October,	81.40		82.87
November,	73.90		77.60
December,	64.32		69.90
Annual averg. at 8 A.M.	80.2	Ditto at 3 P.M.	83.3
Lowest temp. at 8 A.M.	62.	Highest temp. at 3 P.M.	92.

Numerical Table of admissions into Hospital during 1846.

	Diseases.	Jan. Cured.	Jan. Died.	Feb. Cured.	Feb. Died.	Mar. Cured.	Mar. Died.	April. Cured, relieved.	April. Died.	May. Cured.	May. Died.	June. Cured.	June. Died.	July. Cured.	July. Died.	Aug. Cured.	Aug. Died.	Sept. Cured.	Sept. Died.	Oct. Cured.	Oct. Died.	Nov. Cured, relieved.	Nov. Died.	Dec. Cured.	Dec. Died.	Total. Cured. relieved.	Total. Died.	Ages. Cured, relieved.	Ages. Died.	Ratio of death to recovery.	No. admitted far advanced, on an average, on what day of disease.
Cerebral and Spinal diseases.	Apoplexy, ...	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	... ...	30 to 40 1		
	Coup de soleil, ...	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	10 to 20 1			
	Delirium tremens,	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	2	1	1	0	2	0	0	0	7	3	20 to 30 2 30 to 40 1 40 to 50 4	Ditto 2 Ditto 1		
	Mania, ...	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	3	0	10 to 20 1 30 to 40 2			
	Tetanus, ...	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	... ...	20 to 30 1		
	Paralysis, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	10 to 20 1			
Thoracic diseases.	Phthisis, ...	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	... ...	20 to 30 1		
	Pulmonary inflammation, ...	1	0	2	0	3	0	1	0	1	0	0	1	0	0	2	0	1	0	0	0	2	0	3	0	16	1	20 to 30 10 30 to 40 5 40 to 50 1	Ditto 1		
	Morbus cordis, ...	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2	1	10 to 20 1 20 to 30 1	Ditto 1		
Abdominal Visceral diseases.	Hepatitis, ...	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	3	2	10 to 20 2 20 to 30 1	20 to 30 2		
	Spleen disease, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	20 to 30 1			
	Colic, ...	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	5	0	1	0	1	0	1	0	10	0	10 to 20 1 20 to 30 7 30 to 40 2 40 to 50 0			
	Gastralgia, ...	0	0	1	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	10 to 20 2 30 to 40 6 40 to 50 1			
	Diarrhœa, ...	3	0	0	0	15	0	3	0	7	0	3	0	2	0	3	0	4	0	1	0	5	0	1	0	47	0	10 to 20 12 20 to 30 25 30 to 40 7 40 to 50 3			
	Dysentery, ...	0	2	0	0	1	0	2	0	0	0	2	1	4	0	0	3	1	0	9	2	3	4	3	0	25	12	10 to 20 5 20 to 30 13 30 to 40 6 40 to 50 2	Ditto 3 Ditto 5 Ditto 2 Ditto 2	32.4 per cent.	8 on 16th day.
	Worms, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0				
	Hæmorrhoid, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0				
	Dyspepsia, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0				
	Jaundice, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				

Numerical Table of admissions into Hospital during 1846.—*(Continued.)*

Diseases.	Jan. Cured.	Jan. Died.	Feb. Cured.	Feb. Died.	Mar. Cured.	Mar. Died.	April. Cured, relieved.	April. Died.	May. Cured.	May. Died.	June. Cured.	June. Died.	July. Cured.	July. Died.	Aug. Cured.	Aug. Died.	Sept. Cured.	Sept. Died.	Oct. Cured.	Oct. Died.	Nov. Cured, relieved.	Nov. Died.	Dec. Cured.	Dec. Died.	Total. Cured, relieved.	Total. Died.	Ages. Cured, relieved.	Ages. Died.	Ratio of death to recovery.	No. admitted far advanced, on an average, on what day of disease.
Fever, ...	18	1	2	0	5	0	10	0	18	1	44	0	14	0	12	1	29	0	11	0	7	0	6	0	176	3	10 to 20 40 20 to 30 91 30 to 40 28 40 to 50 16 50 to 60 1	20to30 1 Ditto 1 Ditto 1	1.7 per cent.	3 on average of 9th day.
Cholera, ...	0	0	1	0	3	2	3	7	4	8	0	1	1	3	2	0	0	1	1	1	3	2	0	0	18	25	10 to 20 3 20 to 30 10 30 to 40 2 40 to 50 3	Ditto 2 Ditto 19 Ditto 2 Ditto 2	58 per cent.	
Rheumatism, ...	0	0	3	0	5	0	1	0	1	0	1	0	1	0	1	0	1	0	3	0	0	0	2	0	19	0	10 to 20 1 20 to 30 8 30 to 40 7 40 to 50 3			
Scurvy, ...	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	7	0	20 to 30 2 30 to 40 4 50 to 50 1			
Cutaneous disease,	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Syphilis, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0				
Disease of testicle,	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0				
Injury to joints, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0				
Wounds, ...	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0				
Burns, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
External abscess,	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0				
Fracture, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Opthhalmia, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Otalgia, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Bone disease, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Musquito-bites, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0				
Ulcus, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0				
Superficial inflam.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0				
Œdema of feet, ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Fistula in perineo,	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0				
Stricture, ...	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0				
																									445	50	Total ages, 495. 10 to 20 97 20 to 30 267 30 to 40 93 40 to 50 37 50 to 60 1		1 in 10 of the whole.	

The above amount of mortality is rather that of disease in a tropical climate, allowed to run on unchecked, than of disease under regular and ordinary treatment.

Independently of the usual great mortality from cholera, 15 cases in all out of the 50, of dysentery, fever, hepatitis, delirium tremens, pneumonia, were admitted in a stage of advanced progress of the ultimate morbid results of these several diseases, and beyond hope of relief.

Fever.—There have been 179 admissions of fever, all, with two or three exceptions, of the remittent type, and of a very mild character. The greatest number of fever cases have occurred during the hot and rainy months of May, June, July, August and September.

The average length of the fever state, from the commencement out of hospital to its cessation in hospital after treatment, has been during these months eight days, whereas the length of the fever symptoms in the total of the cases throughout the twelve months (calculated with some care) has been upon an average seven days. The relative liability of different ages to fever is seen (upon a very small scale) in the table. The duration of fever symptoms strictly is intended above, not the length of time from the commencement of the disease until discharge from hospital, for several days are always allowed in hospital for recruiting the strength. No one of the three cases in which death took place came fairly under treatment. The mischief had been done in all before admission. In two out of the three death followed in the course of a few hours; in one the accession of a violent paroxysm of fever seemed to carry off the patient. He had been sick on board-ship for three weeks, and had been admitted in the morning without any great heat of surface. It now and then happens, that a single paroxysm of fever is fatal in this country; the disease striking violently, as it were, at the vital powers and annihilating them. The following is a short account of the fatal paroxysm.

"J. G., aged 47, admitted into hospital at 9 A. M., is said to have been suffering from fever three weeks, he was ordered a simple saline febrifuge; $5\frac{1}{2}$ P. M. body and head became very hot, with delirium, followed shortly by stupor and stertor, which lasted until death at 11 P. M.; pupils were dilated; pulse rapid, weak; livid tongue and features from the first appearance of stupor. Post mortem examination after 14 hours :—an excessively loaded and congested state of all the blood vessels of the brain, both superficial and deep seated; effusion of serum to the extent of an ounce altogether at the base and within the lateral ventricles. Portal vessels loaded with blood; a purple congested state throughout the mucous membrane of the stomach and alimentary canal; spleen very soft, easily breaking down under slight pressure."

In the treatment of the fevers of this year, it has not been necessary nor advisable to use the lancet in any one instance. In several of the protracted cases with typhoid symptoms, wine has been found most serviceable.

Dysentery.—The number of cases treated has been 37. The mortality has been very large, viz. 12;—8 of which were admitted with the symptoms of far advanced ulceration of the bowels. There occurred a combination of hepatic abscess with the dysentery in two instances. In several of the fatal cases the disease has passed through the several stages or kinds of the disease usually enumerated, viz. of diarrhœa more or less protracted, of acute inflammatory dysentery, and of the last closing stage, which is very commonly hæmorrhagic, where the dejections consist of a sanious liquid with flakes of membrane, or of a dark reddish coffee-like fluid, or of little else than blood, and that passed in large quantities. In these fearful cases of dysentery, I have found, upon post mortem examination, extensive surfaces of corroding ulceration, smeared with small fragments of red coagula, and extensive surfaces of large sloughs of membrane, the contents of the large bowels being precisely similar to the dejec-

tions. Diarrhœa, of some continuance, is often the first stage of severe dysentery ending favourably. In the case of a lad of 19, admitted in the inflammatory stage of dysentery of several weeks previous duration, with the characteristic symptoms of great abdominal tenderness and tumefaction, with distressing tormina and tenesmus, and the dejection of blood and mucus and shreds of membrane, where death was occasioned by the sudden attack of cholera, the following were the post mortem appearances, of the intestines more particularly, and they were such as, notwithstanding the severity of the symptoms during life, were quite compatible with recovery, had not cholera supervened, namely, colon, its mucous membrane throughout of a somewhat livid colour, the epithelium of the membrane detached in many places and hanging loosely, the mucous membrane highly vascular and of a purple colour in patches, in the midst of these patches were small ulcers, apparently filling up by a process of granulation, their surfaces of a purple colour. I have noticed in several of the examinations of dysentery, a honey-combed ulcerated state of the membrane at the extremity of the ilium, the seat of the small aggregate glands.

In October last a ship arrived in Calcutta from Sydney, having taken in water at Copang, on the island of Timoor, in the Straits, and from that date the crew and officers became unhealthy, almost all of them suffered more or less from dysentery. Upon arrival at Calcutta a number of the men were sent into the Howrah Hospital; several of them had been passing blood for weeks, and the circulating blood in several instances had become scorbutic, evinced by bleeding gums, pallor of gums, and general sallowness of complexion, and, in the after examination, by a softened condition of the spleen: of these cases three died.

In the management of dysentery, I depend upon early bleeding, and the ipecacuanha and mercurial treatment. At

the period at which I have usually resorted to sugar of lead, I have not found it answer the end intended.*

Hepatitis.—Out of five cases of hepatitis admitted, there have been three cases of abscess, of which two have been combined with dysentery of the severest kind, and in one of these complicated cases, in which there existed a further aggravation of pericarditis, the presence of abscess was not suspected, so completely was it masked by the virulent dysentery.

In making a few remarks upon abscess of the liver, I shall give the sum of my experience in reference to other cases as well as to these. In the consideration of hepatitis advanced to the stage of abscess, the most important points are the early detection of abscess, and the prompt application of appropriate means of cure. I have no doubt that many lives have been prolonged since the stimulus given to the early opening of abscess of the liver by Drs. Mouat and Murray. The success of the operation of exploration and of subsequent opening of the abscess depends of course upon its bold and early adoption; otherwise, the chance of success is a very contingent one, depending upon the amount of disease in the liver, the size and number of the abscesses, the particular pathological character of the abscess, the condition of its

* The remark of Dr. Green regarding the inefficacy of sugar of lead has induced us to compare the mortality from dysentery in the hospital under the General bleeding, calomel, and ipecacuanha system, and under the soothing treatment by local bleeding opiates, sugar of lead, astringents, &c. The results are as follows :

Bleeding and Mercurial treatment.		Opiates and Astringents.	
In 5 years.	227 admissions. 48 deaths. 21 ratio of mortality per cent.	In 3 years.	80 admissions. 10 deaths. 12 ratio of mortality per cent.

We are quite aware of the danger of arriving at erroneous conclusions regarding the action of medicines from a limited comparison of facts ; still the above return is undoubtedly unfavourable to the system introduced by Twining, which we believe has long been losing ground with the profession in India.—J. M. P.

walls, &c. Out of five cases that I have operated upon for the relief of abscess of the liver in and out of the hospital, in two only has success attended, leading me to infer that in these two cases happily there had existed but one abscess, the early emptying of which had relieved the irritated system and left nature free to repair the lesion of the organ. In a great many other cases that have come under my notice, post mortem examination has almost invariably discovered two or more collections of pus, or else one large bag, the result of the destruction of a large portion of the liver, and often numerous small abscesses have been found in the organ scattered throughout both lobes, of the size of several peas each or of a walnut. The abscesses are found in all positions and directions, tending towards the front, or towards the back, or side, or in the direction of the lungs and other viscera. As often as not, there is no defined bulging, although the side, as a whole, is generally perceptibly enlarged. In notes that I have of more than twenty cases, I have only mention of one case where any thing like a cyst was found, and in that, in one only of two associated abscesses, a semi-cartilaginous lining to the abscess was found with a rough secreting yellow-white surface, contents healthy pus. More commonly upon post mortem examination of abscess of the liver, the walls are found ragged and shaggy, formed out of the substance of the liver, which is breaking down and undergoing conversion into pus, by a combined process of degeneration and death of structure and of ulcerative absorption; again, the immediate walls of the abscess are often white and devoid of blood, and of a basket-work appearance from interstitial absorption; or in other cases the walls of the abscess may be described as composed of the usual substance of the liver, heightened in colour by increased vascularity, at the same time softened and brittle in texture, and interspersed with minute white spots of deposited matter, these having the appearance sometimes of atoms of suet. Skirting abscess, the liver usually displays

increased vascularity, and is brittle and easily lacerable. In cases of abscess it is common to find the liver in other parts of a pale colour, both superficially and deeply seated. The contents of abscess usually are pus with detached flakes and sloughs of the organ, or else a dirty, thin, sanious, fœtid, and gritty liquid.

With regard to the relation as cause and effect, of hepatic abscess and dysentery, I am inclined to regard the two diseases as contemporaneous or successive, although distinct, products of similar causes, not as dependent the one upon the other; for each is so often found to exist alone, and, besides too, experience shows such to be the insidious nature and course of hepatic abscess, that it may exist silently and go on increasing without exciting recognition, and so may have preceded the dysentery, although, after a complication with dysentery, such a masking of both diseases can no longer remain. Dr. Copland seems to take this view, allowing at the same time the possibility of connection of the two diseases: in one case, not complicated with dysentery, I found greenish purulent contents in the hepatic veins, which appeared enlarged and gaping upon incision into the liver. Of the passage of pus through the portal vessels from the bowels there seems to be no doubt. The subject has been well summed up by Dr. Budd in his work upon the relation between hepatitis and dysentery.

I have almost invariably found the liver closely adherent to the diaphragm, and so to the walls of the chest, through the medium of the peritoneum, and I believe the diaphragm may be penetrated with perfect safety in opening abscess of the liver. I am an advocate for an early opening into the liver with a trocar, first dividing the skin with a lancet, upon a well considered opinion of the presence of matter.

Colic.—Several cases of this kind, of acute suffering, have been admitted into hospital. Four cases have been admitted from the same ship lying in dock, in September, within the

course of a few days. The disease has been attributed to excess in drinking bazar spirits. The pain was most severe, felt at the umbilicus and lower abdomen, extending to the back, doubling up the patient, accompanied by tenderness and tumefaction of the abdomen, constant retching and rejection of a green liquid; the pain of long continuance at a time, and recurring in aggravated paroxysms; there was a loaded white tongue; general pallor; great distress of countenance; damp skin. The complaint had existed in these cases for several days before admission, preceded in some by diarrhœa: relief was obtained in these severe cases upon an average on the 4th day, discharge from the hospital took place on the 15th day after admission. They were left in a low tremulous state with a tendency to diarrhœa after the subsidence of the severe pain.

After such cases cholera often follows. Treatment employed gave temporary relief, but the spasms returned, such as frequent leeching, hot bath, sinapisms, turpentine fomentation, turpentine and assafœtida enemata, laudanum and ether, calomel and opium, aperients.

Diseases of the Spinal Cord and Nerves.

Two cases coming under this classification have been treated in the Howrah Hospital this year, another case treated in the hospital in bygone years has been added, and four other cases treated in Howrah and the neighbourhood, and occurring about the same time, have also been added; the whole forming a group of disease, and taken together, not devoid of interest. I consider rheumatism too indefinite an expression for several of these cases, believing the seat of the severe nervous spasm in some of them, and of the nervous paralysis in others, to be in the spinal cord the nervous centre of motion, as well as in the nerves. The precise abnormal condition of the nervous centre, I cannot pretend to define,

whether appertaining to the blood vessels only, or to them and the nervous tissue conjointly.

Tetanus.—The case of a man, age 29, admitted into the hospital in the middle of May, of a very severe description, followed by death on the third day after admission. The only assignable cause seems to be sleeping on deck at night.

The principal symptoms in the case were locked-jaw; great pain and sense of constriction of the throat, and difficulty of swallowing the smallest quantity of liquid, and difficulty of speaking; severe pain is felt at the hypogastrium, as of compressing the bowels, obstructing breathing, and, simultaneously with it, the head and back are curved backwards, attended with frightful spasms, recurring in quick succession; rapid, soft, pulse; perspiring skin; the attempt to swallow calling into play the whole associated morbid train of spasmodic action.

Post mortem examination 12 hours after death. Externally, lividity of the surface of the back and other parts of the body. Head, very great cerebral congestion of the sinuses and blood vessels of the brain, neither effusion of serum, nor softening of the cerebral substance observed. Medulla spinalis, a pulpy softening of the lumbar portion for the extent of an inch, a few blood vessels distinctly injected ramifying over the medulla at the part posteriorly; general vascular fulness of the other organs of the body observed; nothing remarkable observed in the lining membrane of the wind-pipe. The treatment consisted of large doses of tartar emetic at first, of calomel jalap and croton oil, venæ sectio, leeches to the back, of blisters, turpentine enemata, extract belladon, gr. ss. every hour for 8 doses, extract hemp, gr. ij. for several repeated doses, administered per os et anum.

In another case, in a lad of 19 years, in which decided relief was obtained on the evening of the 4th day, the attack commenced with gastro-enteritic derangement, vomiting and watery purging, burning pain in the epigastrium extending along the chest up to the throat, with a sense of dryness of the throat and globus hystericus obstructing breathing, and great pain and difficulty of swallowing liquids, difficulty also of speaking, respiration hurried at times and attended

with groaning, pulse weak, tongue dry, skin moist; he lapses at times into a comatose state, and is not aroused by loud speaking, his features remaining tranquil; he was treated with calomel and opium, sinapisms to the back, leeches applied high up on the chest; locked-jaw speedily supervened, attended by convulsive contraction of the fingers, and throwing back of the head and gasping for breath; severe abdominal pain and constriction of the throat preceding these spasms. During two days he took seven doses of tinct. hemp, the doses gradually increased up to 30 drops, after which he slept; other means were used, such as aperients, turpentine enemata, setting him over steam whilst enveloped in a blanket, blister to nape of neck. He constantly refers to his throat as the seat of pain, pulse rapid, bowels well moved. At times fits come over him, of a few minutes' duration, and of frequent recurrence, in which, with closed eyelids and reposing features, the teeth become closed and the fingers contracted, the pulse during the time being slightly retarded, the pupils active, the attention not to be aroused; he then seems to awake out of the state, sighing, and panting for breath, pointing to his throat as if feeling sore: tinct. hemp was again administered on the 3rd day. On the evening of the 4th day felt comparatively well, and recovered shortly.

In two other cases occurring in Europeans, one aged 30, the other 35 years of age, in both of which anxiety of mind and much exposure to the sun and wet weather seem to have concurred in the production of the disease, the symptoms were as follow: paroxysms of lancinating pain in the back of short duration, recurring at short intervals, making the patient scream out; the slightest movement and the action of vomiting bring on severe cutting pain in the dorsal spine, the pain during the paroxysms extends upwards to the neck and occiput, attended with constriction and uneasiness about the throat and jaw, and with difficulty of breathing, speaking, and swallowing; there is heat of head, quickened pulse, incessant thirst, vomiting, the skin perspiring. In one of the cases the head and back were convulsively retracted during the paroxysms of pain, and cramps in the muscles of the legs were felt. Recovery took place in each of these cases, after a few

days. Treatment, leeching largely to the head and back, sinapisms and blister to the back, setting them over steam whilst well covered up, opiates, aperients.

Paralysis of a rheumatic character occurring in a boy of 14 years of age, after confinement to his cot at sea in consequence of sore legs. He began gradually to lose the use of his limbs, the paralysis having been preceded for a week by severe abdominal griping. Without having previously experienced pain in his head or joints, he has become quite unable to stand, having lost all strength and power of support in the ankle-joints; he cannot now raise either thigh upon the pelvis, or raise the arms at the shoulders; he has nearly lost all voluntary power over the ankle-joints, and over the joints of fingers and toes; he experiences a sense of numbness from the knees and elbows downwards; the muscles of the lower extremities are much emaciated; there is slight tenderness on tapping the dorsal spine; he is conscious of tickling when applied to the sole of the foot, although not of pinching it. Whilst taking strychnine one grain in the course of four days, continued for 16 days, he experienced creeping and tingling sensations in both legs, startings in his sleep, and occasional headache and giddiness. The treatment consisted of a blister to the back low down, strychnine, cold bath, and, especially, of constant use of the joints by causing him to try to support the weight of his body, and by repeated motion and friction of the joints. In less time than a month he walked well alone; too violent exertion during the progress of his restoration occasioned headache, and a feeling of tightness of the hamstrings, and threw him back for a day or two.

In another somewhat similar case of paralysis, in a man of 30, only of greater helplessness, in which the feet were quite, without the influence of the will, and perfectly useless, dangling at the extremities of the legs as if attached to the legs at the ankles by joints of leather—the history given was obscure; the man had been a free liver, had seen vicissitudes of fortune, and been exposed in the course of his life to severity of climate; he dates his present complaint from a cold caught on the river six months ago; that he then began to experience symptoms of paralysis in both lower and upper extremities with loss of memory; he was admitted into hospital perfectly bed-

ridden, unable to raise his lower extremities off the bed, there is increased sensibility to touch of the shrunken lower extremities, particularly about the calves, and a stiff contracted state of the hamstrings; no pain on tapping the spine; he does not sleep at night, and there is considerable morbid nervous anxiety about him. In the course of three months after the same sedulous use as above of motion, and gradually bringing the loosened joints to bear weight, and general tonics given internally, he began to walk with support, and rapidly recovered afterwards.

Another case occurred this year in the neighbourhood of Howrah, partaking of the nature of the two last cases, and referable, I am of opinion, to spinal medullary irritation or morbid alteration of some kind; the patient, an old soldier, of 50 years old, has been subject in other years to severe pains and numbness of his lower extremities; this year, after having ailed at different times from diarrhœa and rheumatism, towards the end of the rains he was attacked with the following symptoms, viz. vomiting after taking his food, general uneasiness of body, giddiness, he complains of exquisite sensitiveness and soreness of the whole surface of his body, so that he cannot bear the least pressure over him, or the slightest breath of air to blow upon him without experiencing great pain; he has a sense of tightness across his chest, and weight at the epigastrium, with some little tormina and tenesmus; numbness and loss of power of extremities and joints generally, and general prostration; no pain felt on tapping the spine. He improved considerably in about a month, and after a trip to the Sandheads. The treatment consisted of aperients, hot bath, sinapisms, soothing doses of antim. potass tart., c. tr. opii., blister to the back, enemata; latterly quinine and port wine to recruit the shattered strength.

Morbus Cordis.—Several interesting cases of disease of the heart, in all seven, have been admitted into the hospital during the year; the disease having been recognised by the symptoms during life, and the diagnosis, in some of the cases, confirmed afterwards by post mortem examination. Of four cases in which an opportunity of examination occurred, complications of other diseases existed: in one dysentery carried off the pa-

tient; in one dysentery and hepatitis; in one delirium tremens; in another case of extensive endocarditis, complicated with dropsy into the large cavities and bronchitis, death is attributable to the sum total of the diseases taken as a whole. In two other cases, not fatal, rheumatism was associated.

The forms of the heart disease met with have been pericarditis and endocarditis, hypertrophy and dilatation; placing in juxtaposition the ordinary physical signs and those by auscultation, with the post mortem appearances—

I find that in case 1st, (death by Dysentery) the heart symptoms were pain and oppression of chest, and difficulty of breathing, coming on in paroxysms; also occasional momentary shooting pain through the heart. By auscultation, a bruit heard over the heart, with increased natural sound heard on the right side of the heart. On examination there were found within all the cavities of the heart clots of black blood, and leathery, colourless, coagula adherent to all the valves; a granular condensation of the mitral valve at its edge and throughout it; left ventricle very much thickened and contracted in calibre; of the right ventricle the walls much attenuated.

Case 2nd.—(death by Delirium Tremens). The man's restless state did not admit of auscultation, he complained of palpitation; any other symptoms were masked by the delirium.

There was found hypertrophy of the left ventricle; the lining membrane of the ascending aorta and of its arch was found much thickened, atheromatous, with spiculæ and plates of bone embedded in it; the calibre of the aorta at the part dilated.

Case 3rd.—Heart disease with bronchitis, followed by dropsy into the pericardium and all the cavities; the chief symptoms referable to the heart were distressing paroxysms of difficult breathing and of palpitation; rapid small pulse. By auscultation, the sound of the heart loud and of great extent; the action of the heart tumultuous, not of increased impetus, attended at first with splashing noise; a rough, somewhat rasping, sound of the heart heard a good deal to the left and under left arm; the sound of the heart beneath the left breast of a ringing metallic character also, in connection with the systole; impulse of the heart increased at times; both sound and impulse

of the heart at last became smothered. On examination there was found hydrops pericardii, dilatation of both ventricles, endocarditis in the shape of leathery thickened mitral and tricuspid valves, inflammation of the aorta at the root of the semilunar valves, with ulceration and perforation of the aorta at the part; inflammation of the lining membrane of the pulmonary artery also.

Case 4th.—Death from dysentery and hepatic abscess. He complains of difficult breathing at times, and of pain across the chest, and of tenderness on pressing under the margin of ribs on left side: heart's impulse not increased; he has felt the same morbid sensations for a short time many years since: the heart disease of old standing. By auscultation a strong bruit is heard attendant upon the systole all over the heart. Upon examination there was found the closest adhesion of the pericardium to the heart, without any apparent alteration of structure, so that the bag of the pericardium at first sight appeared to be wanting; the pericardium was separable from the heart by careful dissection; the heart, with its closely attached pericardium, was attached to the diaphragm, instead of having the bag of the pericardium to move in.

Delirium tremens.—Ten cases of the disease have occurred in the year, some of them slight; there have been three deaths, one of them in a man a few hours after admission in a dying state. The post mortem appearances of two habitual drinkers exhibited considerable vascular fulness and congestion, as well of the scalp as of the feeding veins of the longitudinal sinus on the superior surface of the brain; considerable effusion of serum within the sac of the arachnoid superiorly, and at the base of the brain, and within the ventricles of the brain, and beneath the arachnoid, found also within the spinal canal; milkiness of the arachnoid, and adhesion of the two surfaces along the line of the longitudinal sinus; a highly injected state of the pia mater, and appearance of bloody points upon slicing the brain. In one case an apoplectic cell of the size of a nut, filled with coagula, was found at the inferior part of the anterior lobe of the right hemisphere.

I have found the best treatment to be large and repeated doses of laudanum, employing at the same time free evacuants and external counter-irritants.

Insanity.—Three cases have been admitted; ages under 20, one; between 30 and 40, two; all three of them of many months previous duration. One of the cases amounted to dementia (age 38). He had been in hospital for a few days at the end of April, but, being quite inoffensive, was discharged. He was re-admitted, May 30th, in a state of apoplexy, or near akin to it—(the post morten is interesting,) admitted at noon, died at $4\frac{1}{2}$ P.M. He was at work, cleaning decks in the morning, seemingly well 4 hours before admission. Symptoms on admission, heat of skin; heavy breathing; does not reply to questions; full, bounding, but compressible pulse; pupils inactive, contracted; low muttering; picking at bed clothes; he had been exposed to rain in the night; he was bled, leeched, blistered, &c. Upon examination 20 hours after death, in May, the dura mater at the parietes of the brain was found thickened and hard in texture; serum effused into the bag of the arachnoid and also beneath it; the superficies of the brain appeared ex-sanguine rather; upon examining the base of the brain, the cortical part of the whole base of the brain, and more particularly on each side centrally, was found to be of a green colour, and softened, and appeared much thinned, and separated readily into loose shreds and flocculi upon handling; the whole of the cerebral substance at the base of the brain, as well as the optic thalami and corpora striata, was softened; upon dividing the tentorium cerebelli, previously to removal of the brain, exit was given to a quantity of clear fluid, three ounces, which must have been confined at the base of the brain; the lateral ventricles of the brain were found distended by fluid to the extent of an ounce or two; cerebellum softened also.

Pulmonary Disease.—There have been admitted one case of phthisis pulmonalis, aged 24 years, and eleven other more or less acute cases of bronchitis, pneumonia, and pleuro-pneumonia (omitting catarrh), ages of these cases between 20 and 30, seven; between 30 and 40, four. It has been ne-

cessary to employ the active measures of general bleeding, leeching, cupping, large doses of tartar emetic, and blisters, in several of these cases.

One case, age 37, was admitted after active treatment on board-ship for five days, in the last stage of the disease; with hurried, catching, and most painful breathing, and with severe pain shooting across the left breast and side: in this, high delirium came on the very night of admission, followed by clamminess and sinking, and death the next morning. Signs by auscultation, râle crepitant at the seat of pain on the left side, respiratory murmur indistinct there and tubular, an occasional guggling sound heard beneath left arm. Upon examination 5 hours after death, enormous congestion of the blood vessels of the brain was found, more than a pound of blood escaped during the division of the scalp and sawing through the bones; the arachnoid milky in places; effusion of serum to a small extent; brain of healthy firmness.

Chest.—The pleura, lining the sternum, was adherent to the pleura, covering the pericardium; a thin layer of yellowish, soft, false membrane interposed between the inflamed and deeply reddened pleuræ at the points of adhesion; the lung on the left side in front adherent to the lining of the ribs; the whole lung was covered with an almost continuous covering of this false membrane, which dipped also into the sulci between the lungs; the lung on this side externally of a dark-purple colour, more particularly so at the dependent parts; upon division the substance of the lung of a dark-purple colour pouring forth black blood, its texture, particularly so at the dependent parts, softened, giving way beneath the fingers; drops of healthy pus exuded upon slight pressure out of the cut bronchial ramifications. The pleura costalis was likewise inflamed and smeared with the same kind of false membrane; about half a pint of yellowish serum was found in the bag of the pleura on this side. The same disease was found on the right side but to a less extent: no internal pericarditis found.

Scurvy.—Seven cases have been treated besides several others of scorbutic rheumatism, the cases have not been of a

very severe character, readily yielding to fresh provisions and fruits, and acids generally. Rheumatism is often found occurring in the same ship with scurvy, as a grade and variety of the same disease, which consists essentially in a depraved state of the blood. Something explanatory of the nature of scurvy is observable in the condition of the natives of this country, particularly during the cold season. They commonly exhibit then a number of scorbutic phenomena, such as spleen disease and ague, bleeding gums and bleeding hæmorrhoids. Scurvy is commonly observed to break out during continued bad weather at sea, after much wet weather—there is an analogy therefore between the two cases—allowing for a certain depression of vital power and energy, the effect of the lowered temperature of the air, and considering it as an agent in the production of the disease, I would enumerate, as a material cause of scurvy, diminished cutaneous perspiration, and the consequent retention of serum and dilution of the blood. Dr. O. Rees in his Gulstonian lectures further minutely explains the effect of this dilution and lowering of the specific gravity of the blood, thus: "the globules of the blood, by absorbing the surrounding serum of lowered specific gravity, become less capable afterwards by the laws of endosmose of attracting to themselves the ferruginous and nutritious part of the chyle."

Syphilis.—Forty-four cases have been admitted, out of these, two only of secondary syphilis; all have proved of a mild character.

Cholera.—Forty-three cases have been treated, out of these, there have happened 25 deaths, the ages of all, and of those that died, are shown relatively in the table. The greatest relative proportion of mortality in this disease takes place, according to these very scanty data, at an age between 20 and 30, the period which is the prime of life certainly with the sailor; and is probably to be explained by the consent of

vigorous life and vigorous disease, as is observed in the phlegmasiæ. In choleric seasons, attacks of gastric disorder from excess, of colic, diarrhœa and dysentery, are often observed to precede cholera at varying intervals.

Tænia.—Two cases have been treated, the worm passing away in small joints only, attended by severe griping pain.

Lecture on a new property of Magnetism, Delivered at the Royal Institution. By Professor FARADAY, D.C.L., F.R.S., *&c.*

Slow advance of science—form of a powerful electro-magnet—its power illustrated by experiments—magnetic curves formed in the air—effect upon an iron chain—magnetic bridge of iron—no attraction of lead and some other metals—magnetised paper—new property of magnets—illustrated by bismuth—repulsion of this metal by the poles—magnets attract some bodies, and repel others—phosphorous repelled by the magnetic current—diamagnetism—all bodies attracted or repelled—the latter class most numerous—lists of magnetic and diamagnetic bodies—diamagnetic properties of water—substances, whether liquid, solid, or pulverulent, point axially or equatorially—magnetic and diamagnetic properties of air in different liquids—vegetable substances, if longitudinal, diamagnetic—magnetism of the earth—phenomena of the dipping-needle—source of magnetic attraction near the centre of the earth, not at the poles—relation of diamagnetism to terrestrial magnetism.—Conclusion.

Since the time that Lord Bacon taught us how to examine nature by experiment, such an immense advance has been made in the investigation of natural philosophy, that we are prepared at the present day to expect a progress onward even from week to week, or at all events from month to month, without any great surprise. But when one considers the general system of nature, which changes not; that all its laws were established from the beginning, although we may discover new facts, and perceive new relations of things, and read laws of nature we call *new*, but which are as *old* as creation; it must occur to the mind as science advances more and more rapidly, because of the light thrown upon it by our predecessors in philosophy, and because of the increase in the number of students, still it increases the difficulty to any one body, or one individual, or one nation

now a days, to make any considerable advances. And further, here is this singular point: according to my mode of viewing matters, we are always inclined to feel in reality, although we acknowledge the contrary in principle, that we think we know every thing. There is a feeling in the minds of many, that we are already in a position to give an answer to almost every question. There is an irresistible tendency in the minds of many persons to this conclusion.

Nevertheless, we are slowly making progress, and to-day it is my duty to bring before you a step in advance in science; that is, to describe a new condition of our knowledge of matter, a new condition of the force we have called magnetic, and which you have seen exhibited in various forms, by a current, and by independent pieces of ferruginous substances. I shall endeavour to make you acquainted with this first gleam of knowledge, for it is only the crudest notions we can expect at present, since these facts are quite new to us. I shall try to make you acquainted with this first germ of what I believe will be a great branch of knowledge hereafter. It relates to a new kind of knowledge—to our knowledge of the *power of magnetism over matter*, and of the capability of matter exhibiting a force beyond that of gravity, or chemical affinity, or even electric action such as it is known at the present time.

I must ask you first to look at my large magnet, although you have seen it before, inasmuch as the development of this branch of knowledge must depend on the condition or power of the magnets. I will for a few moments hold your attention to this electro-magnet before me, and of which there is the larger part below the table. [The enormous poles only of a horse-shoe electro-magnet were visible on the table.] It is a bar of iron, and there are wires round it, which wires go to a battery. We have here, then, a very powerful electro-magnet, with this beautiful condition, that we can make or unmake it at pleasure,—that having the extremes or poles together, I can vary the form of the poles, and make them come nearer, or go further, by putting on moveable masses of iron of different shapes. I have here an enormous amount of power, but I can create it and destroy it *in an instant*. Two or three experiments will shew it at once, from which you may form a comparative judgment hereafter, either next year or ten years hence, when this science has made still

further advances. I give you that kind of action which Volta used when he first discovered the battery. I may not bring my tests [large bars of steel weighing many pounds] in close contact with these poles; if I do, perhaps I shall never get them off again, or at least during the lecture. I must put something between them—a piece of board, for example—which I can easily lift off again. Contact is made, and we have now the magnet in full power; you may see the difficulty of moving the heavy mass of iron away from the poles. I might almost pull the whole table down by the attractive force of the iron beneath influencing the magnet through the thickness of this board. You have seen nothing like this power before. It would suspend many tons weight of iron. It is only by seeing facts of this kind that you become aware of the enormous power I am about to use in the applications I shall make to show this particular kind of phenomenon. I take two bars of iron; on making contact they become one bar. The moment contact is broken it is unmade; and the beautiful condition which we have of making and unmaking, of giving or destroying an extraordinary force, is one essential point in the manifestation of this phenomenon. I should like you to see the condition of the magnetic curves as shewn by means of this arrangement, and which we can soon exhibit by sprinkling a few of these nails on the mill-board. You saw where the two poles were placed; you see how inert the nails are at present. We will make them magnets, and then see how the curves run together. It is almost unmanageable, for as soon as a plate covered with nails approaches the magnet, it attracts them so powerfully as to strip it entirely of its contents. You see here an illustration of the tales in the Arabian Nights' Entertainments. Mark the way in which new powers are given, and bodies of enormous weight are held firmly together. Observe this line of nails actually rising into the air, and tending to make curves such as I shewed you on a former occasion. It is a curious and beautiful thing quietly to look at this action. This is merely incidental; I only shew the point to illustrate the power of the magnet. When contact is made, if I lay a few nails quite at the extremity of the mill-board, they fly instantly to the others in the centre. You see how strong the curves are here, compared with the line of force, by the manner in which they

are drawn. The force is still more powerful when I bring the extremities of the poles close together. Here is an iron chain; and that you may have some notion of the manner in which a body is influenced, I will let you see the effect the magnet has on this chain. I have here got something apparently different from what I had before: I have got a body which I can bring into any shape, and which appears to be, while under this magnetic influence, a soft solid substance. I have now formed it into a bridge in the air. The parts cannot separate, because they are connected by links; but they are also kept from separating by the magnetic influence. When contact is broken, it becomes a common chain as it was before. In this manner you get a beautiful indication of the strange condition of the space extending between pole and pole, by all the matter brought into it. At present I am giving you common magnetic effects; by and by I will give you others.

It is worth while to show that, as regards *lead*, there is no action of this kind; it makes no difference whether there is a magnet or not. These leaden balls roll about just as before, there is no place of rest, there is nothing determined by the magnet upon the lead under these circumstances. There is an effect which I want to show you, but I will show it by and by with other substances than lead. Still, as regards common action, there is none on these bodies. Here are some iron filings, which are very beautiful and very instructive, because they teach us better what goes through the whole space than does a nail or two. When contact is made you see first that the power affects the edges most; I make the extremities pointed that I may get an increase of power on the points. If I put the whole of the filings down they fall into a mere unarranged mass, taking any shape you please; but when contact is made we can draw them out, and it is beautiful to see the manner in which they hang on each other. Observe the broken lines of force which they represent, and the mode in which you can raise an enormous amount of matter against gravity. Having been formed into a mass, you can make them into a bridge or arch in the air. It is remarkable to see such a space influenced, and the power imparted through the current.

Having given you these illustrations of the power of magnetic matter, I must point out that we are able to get a power from mag-

netic force which this magnet will not give us. If I remove all these things away for the present, take away all the iron, and, as far as I can, clear the table, you will be able to see that I can get magnetic phenomena from this magnet, which before I could not. I am about to roll up this *paper* into a cylinder, or hoop, or roll, for the purpose of showing that it is most likely magnetic, for I never yet found a piece of foolscap paper that was not so. I have taken some pains to keep this paper clear from all impurities of a ferruginous kind, and if I make a nice suspension, I shall be able to hang it between the poles of the magnet and to examine its state. I am now drawing your attention to an arrangement that I am able to turn to account in further examination. The one I have here is in the open air, that you may see all things which occur in it; but I shall by and by adopt another plan to show you the particular phenomena. Here is a piece of cocoon silk, and here are some copper wires, all of which are perfectly free from magnetism. They have been tested by this powerful magnet, and unless they were perfectly free they would not serve my present purpose. If I take this paper and hang it up near these poles, using this little piece of cocoon silk for the purpose of suspending it, and then ascertain whether it is a magnet or not, perhaps to your surprise, and to my surprise in the first instance, it will prove to be considerably magnetic, and will point as a piece of iron would do. I expect you will see that when I shall make a magnet of that which is indifferent and will point anywhere, that most likely it will point between the poles. Contact is made, and we shall see whether it takes up an axial position. If it does, and vibrates, it is magnetic. It does so, and tends to rest between the poles of the magnet. If contact is broken it will take what direction the wind gives it. When the contact is renewed it will become again magnetic. You see how quickly it obtains a new action and goes to the poles by becoming magnetic.

Observe this arrangement. I have ten or twelve cocoon threads which are capable of holding that or any other weight. They have no torsion, no twist of themselves, and therefore they will hold the weight without tending to twist or untwist. All I have to be careful of is to avoid the currents of the atmosphere, and then I will give you this motion as a test of every one that takes place. I am now

about to proceed to an arrangement in which I shall be able to show you that which is a new characteristic of this force of matter. In order to get these effects, I have to be exceedingly careful of my arrangement, and I ask you to be satisfied with small results, small as to the amount of action, but not small as to principle. I must arrange the apparatus in such a manner that I can place substances between these two magnetic poles, and must employ such substances as will enable you all to see it. I must so place them as to afford protection from the current of air in the room, so that I may leave no deception or chance of deception on your minds in reference to the phenomena that take place. I must ask you to spare me a few moments while I arrange the apparatus, of the necessity of which you will have evidence as we proceed. This is a glass screen to prevent the effect of a current of wind. If I put a glass plate on this side, and another on that, I may be able, without hiding things from your observation, to get a movement visibly induced. Here are the centres on which I am about to make a lever move. This is a very fine needle point, and here a long lever, and the centre of motion shall be that tube. I mean to place this end free from the action of the air whilst I make the centre of motion between the poles. I want to bring the poles to act on the substance outside. If I allow this short end of the lever to go upon that end, then all will be free to move. I hope this little cylinder of bismuth is sufficient to counterpoise that end, allowing free motion and showing a new action. The very circumstance I have told you, that we are now engaged in examining new phenomena for the first time in public, must be an excuse for the rough arrangement before you, and which is only the temporary one of a first discovery. If I take a screen so as to allow the ends of the lever to be seen, you perceive it is free to move away, and these being moveable poles, I can bring them upon the one side or the other of the bismuth, and so submit it to the power of these poles. You will soon distinguish between the magnetic force and the new power that moves it by every current through that arrangement. You see clearly—for I allow this pole to come on this side the bismuth—that when that end of the needle moves to my left, this piece of bismuth must be repelled by the pole on my left. It is evident, the things being crossed, that if that

moves one way this must repel it. The needle is at the axis; I am not touching it, but the moment I bring up this pole of the magnet I send it round. Merely by the repulsion of that pole, making and unmaking the magnet, by acting upon the bismuth I can repel it from the magnet. This is utterly unlike what you saw with the iron. When I drew off the iron cylinder, it went back with great power, I could not pull it from the pole; but here the power of the magnet is to *repel*, not to attract. I am not acting by the north pole of one magnet upon the north pole of another. I am taking a substance in its natural state, *not magnetic*, and acting on a pole, and we have found a substance which is *repelled* by the magnet, and not attracted. Up to this time you have known of no substance but what was either *attracted* by the magnet or indifferent to it: I have shewn you the indifference of copper, except a current is going through it, but now I show you another property, I show you *repulsion*, and I could, if I had time, show that this property is universal, far more so than anything you have seen before. Although not so great in amount, nevertheless it is a power equal to gravity, it is even greater than gravity in the mass with which we are now concerned.

I will show you one other substance, and very different to the metals, in order that you may see the effect. I will take a piece of phosphorous. Phosphorous is rather a delicate thing to handle, especially in warm weather like this; nevertheless, I should like to give you a proof that substances, other than metals, have this property, because I want to show that all bodies are affected. We shall succeed as soon as I get the larger part of the instrument into the chamber. Though the indicating cylinder is the same, you will soon see the action that takes place, and if I get the action I will not care about the rest. First, I bring up this pole; on making contact, there is the repulsion. By unmaking and remaking it is stopped by the reaction, only it does not touch, and now you see it is repelled again. I might take you to hundreds of bodies and find them all attracted as iron is, or repelled as bismuth and phosphorous are. There is no one body that is not subject to the one or other action of magnetic force. It is an universal law of nature that *every body in a solid or liquid state is attracted or repelled by magnetic force.*

Taking down this apparatus, and giving you another form, there comes out a very odd consequence, which in fact was the first consequence we met with in this investigation, viz.: that bodies when they are submitted to this kind of action take up a position very unexpected, and utterly unlike anything that we looked for or thought of, or hoped for, in magnetic action. You will easily see that I have something like the other apparatus, a very weak suspension of the silk, with a hook below of copper wire, free from magnetic action. I have stuck a piece of paper on the upper part to make the motion sensible, which paper is fixed to the hook, and therefore will move with it. On that hook I can suspend bodies, and submit them to the action of the magnet. I hope by a little shading of these two poles I shall shut out the air so as to give an idea of the influence of the magnet when bodies are submitted to it in another form. You have seen repulsion—here is another more beautiful form. Here is a piece of bismuth, and I am about, by this silk thread, to suspend it in this little cradle, and then bring it into what I have called the magnetic field, into the place of action between the two poles. It is indifferent so long as the arrangement is not magnetic, but the moment the two poles begin to act upon it, the bismuth will point, but point in an odd position. By making and breaking contact, look how it has swung round. By making contact it will not go round this line, but will swing about that line, and in fact that is the line which it will, at last, take up. Just as the piece of paper swings about between the two poles, so this swings about a little across the poles, or at right angles. When you think of the north and south of the earth, and that this substance is subject to the earth's power, it will point *east and west* instead of north and south, or across the lines of magnetic force. I let it swing, but you see that the power of torsion is such that it will go by; but before it can pass the next time, I will catch it by the magnet, and you will see it sent back. Making contact, it is sent back by the magnetic force, and will vibrate only across the line.

I might show you many other cases of this description: phosphorous will do the same thing. Every body is repelled by one pole or the other if put into a long form, even if composed of several little bits put together. I may take grains of sand, put these into

a tube, make them into a long cylinder, and it will stand along the line of force as bismuth did, precisely contrary to what the magnet does, forming a beautiful contrast to it; and then the phenomena show us that this magnetic force not only has that same kind of duality as respects electricity, as respects northness and southness, but it has another duality, it has that kind of power which makes it magnetic as iron, but in a contrary direction. But we now pass from iron and nickel, the first condition, then nought, and then beyond that to another, the reverse of iron. There is a table behind me to show how various substances are placed in relation to magnetic and diamagnetic action.

Magnetics.

Iron.	Palladium.
Nickel.	Crown glass.
Cobalt.	Platinum.
Manganese.	Osmium.

Neutral.

Air and vacuum.

Diamagnetics.

Arsenic.	Flint glass.
Ether.	Tin.
Alcohol.	Heavy glass.
Gold.	Antimony.
Water.	Phosphorous.
Mercury.	Bismuth.

From iron to osmium these substances are magnetic. Air and vacuum come into a strange neutral condition; and after them come the other bodies as diamagnetics, from arsenic to bismuth, and a thousand more that might be added. I have shewn phosphorous and bismuth, because they are striking; and I will shew water, because, when you see that *water is magnetic,* you will have a better insight into the phenomena of nature than if I left you without that indication. It is not so diamagnetic, to distinguish it from magnetism, as bismuth is, but it is very much affected. Here is a little tube which contains pure water, the glass of which is so nearly balanced in the diamagnetic and magnetic part, as not to be affected.

When I place it thus in the arrangement, you will have the action of the water itself as a magnetic body. The action will be shewn not so beautifully as if I were alone, philosophising in private, but I trust I shall shew it you. Now I will put it in and repeat the experiment, and see what becomes of the water when submitted to magnetic action, whether it is indifferent, or a substance exhibiting this new and beautiful diamagnetic force. I have put it in sufficiently large to be seen, or if not, the paper indicator will make it evident as to whether it points or not, or whether it points equatorially, that is, across the current,—or axially, that is, between the poles. We have not much power in water; therefore I must be careful that I do not touch it. On contact being made I see it is acting, and will not pass the axial point; it will not point as a magnet, but swing back. On again making contact, you will find that it does not pass the axial direction, but vibrates about the line across. It is coming to rest, and will finally take up its position. The two ends of that cylinder of water are being repelled, and sent in opposite directions. You see how beautifully and perfectly the water shews the same action as the bismuth and phosphorous, *pointing east and west.* It is only a want of time that prevents me shewing you fifty other bodies exhibiting the same kind of action.

Now, that you may be taken from these few general observations a little deeper into the mystery of these things, I must point out the condition of air especially, as in my view of things the condition of air, as a natural substance, is the most important part of this kind of action for us to pursue. I will now take a tube of air and place it between the poles of the magnet; it does not point either in this direction or that. The glass tube, if it be at all influenced, will point the one way or the other, according as it is made of plate or crown glass. Crown glass (containing iron) is magnetic, and plate glass is diamagnetic; but I will give an illustration. When a glass tube is taken, filled with air and sealed up, and put between the two poles, I cannot perceive that there is any kind of action. But you must not suppose this shuts out our observation of this action. By no means; we get action, which, strange to say, I am hardly able to impress upon the minds of those who are the best prepared by previous study to comprehend such phenomena, and the general

effects. I am able to shew you air or vacuum either magnetic or diamagnetic at pleasure. When I put substances between the two poles of the magnet, in order to examine their properties, I must not forget their nature. When I am examining bismuth there is air all around it; if it had power it might influence it, but it has not. If, however, I put iron, nickel, cobalt, or water, I find the medium between the two poles, and which is the magnetic field, has a strong action. Here is a jar partly filled with a solution of iron, and partly with water. [The water was floating on a saturated solution of green sulphate of iron.] There is a separation about the middle; it is occasioned only by the difference of gravity; it is one jar of liquid, but the lower part is iron, the upper water. The weakest solution of iron is magnetic; water is diamagnetic; therefore I have two liquids, which, if I put in this place, I can make the medium through which the lines of magnetic force will act. You see that part of the space between these two points is now occupied by water; and if I raise up this jar and put a board under it, the space occupied between the poles will then be a portion of the solution of iron. I am now about to show you, that the tube of air will appear magnetic, or diamagnetic just as it happens to be immersed in the water or in the ferruginous solution. As far as we know, the air that surrounds our globe may have some remarkable relation to it in regard to magnetism. I think this suspender seems nearly fitted to take the tube, and carry it into the solution. First observe, it is a tube of air sealed and sustained in a cradle of copper wire; and beneath the tube, at the middle part, I have placed a smaller tube containing mercury, which serves for a counterpoise or ballast, to make the tube descend into the solution or water, and keep it beneath the surface. Then there is a card above, which, being parallel to the tube itself, will shew you the position of the tube as respects the place of the magnet. This is now suspended; I am about to put it in; it will sink to pretty nearly the level I want; if not, I can raise it by bending the wire. The adjustment will bring it to the centre of motion, and place it so that it is perfectly free to move in the jar. I am taking the risk of the current of air in the room moving the indicator, because I want every thing free, that you may comprehend the beauty of the experiment. The tube of air is now free to move,

and at first stands rather obliquely across. Contact will be made, and we shall see whether it goes to the axial condition or not. See how regularly it is progressing to its position, and it will stand at last between the two poles as the piece of paper did, and it will take no position but that between the poles so long as it is surrounded by water, alcohol, ether, which make it take that magnetic position. I now have the opportunity of raising this jar, without disturbing the apparatus in any other respect. You see the things remain unchanged, except that it is now in the solution of iron, and it stands as I place this piece of wood. On making contact you will soon see that, although it is in that heavy fluid, it is vibrating rapidly, and will stand in this position. The air will take up the diamagnetic position; it will not move from it; that is its true position in a magnetic body; so that you see the air is a magnetic body in water, and a diamagnetic in a solution of iron. Take any one body out of the list, say flint glass; it is a diamagnetic body to those above it, but magnetic to those beneath it. This is settled, you cannot make a distinction; all bodies come to one category; they proceed by degrees; and air, vacuum, and all gases, are in the middle of these.

Having given you these brief observations, I must occupy the time that remains in bringing to your attention what will be the natural consequence of these beautiful actions of matter. Whilst I give you inanimate and inorganic bodies, it does not seem surprising to tell you these things. If I come to show you that *organic matter* of all kinds is liable to this action, it is a different thing. Here is an apple which is diamagnetic. It is magnetic, speaking in a general sense, subject to magnetism, but it is really a diamagnetic body. When I tell you things of this nature are subject to magnetic force, and not only subject to this force, but all magnets, remember all these things we are dealing with are magnetically related to the earth just as much as the needle on which the mariner depends for instruction in his voyage on the surface of the ocean. When you reflect that these are the consequences that follow, you may perceive the strong effects of this power when it can act on these substances so placed as to be liable to the action of the earth. It is in this view I take up a case or two. Although the apple be decayed, I have no doubt, if it contains no iron or ferruginous body, we shall find it diamagnetic. We

can soon test it. If I place a piece of copper wire—and all this copper wire has been examined—and hang this up so that it shall come between the poles of the magnet, and the thread is able to bear it, I have no doubt that it will point. On making contact, it stops the vibration. That slice of apple will vibrate about this line. It will not pass beyond except from some gust of air. As long as it is exposed to the magnet, it will point equatorially, or contrary to the magnetic needle. It swings right and left; it is a diamagnetic body by virtue of the water and other principles it contains. I have tried it over and over again: I have not tried asparagus, but will do so now to point out to you and satisfy myself that these bodies are diamagnetic, because it is an important point to us, or at least will be so hereafter. This piece of asparagus will show for itself what position it takes up in the magnetic field. It is only requisite that we should take a longitudinal substance and then the thing points. Making contact stops the action; it went back when it came to this line; it will not go beyond it, but will take up this equatorial position. I might put a mouse there, a flounder, or anything that is elongated in this direction, and you get the phenomena. You must have *longitudinal* bodies to show this effect; and you see how beautifully this substance is vibrating across the magnetic force.

I must occupy the rest of the time, the few moments that remain, in speaking of the magnetism of the earth, which I fear is not distinctly understood as it regards the nature of the lines of force, and the condition of bodies on its surface.

I have told you before that the earth is a magnet, and you know it by the way in which a needle points upon the surface. But it is not a magnet, like that needle. It is not as if we had a large magnet extending from end to end from the south to the north poles but it is more as if the magnetic force were something dependent on the equator. I will build up an earth to show this. You must not mind the form of apparatus I am about to use. Assuming this bottle were the earth, making the neck the pole, then putting round this earth of our's currents of electricity, you see how differently they come out to what they would do if they were suspended. Here is a globe around which I can throw currents of electricity, which you know are magnetic from the effects you have seen from this battery.

I will throw the magnet out of its direction; we shall get it round this circuit. You will remember what this indicator did with the bar magnet; one end pointed at one pole and the other at the other, and the thing travelled round and stopped parallel in the centre in a curious way. See what it will do here. On making contact it is affected; you see that by the way the needle moves. But observe how it is affected; it is by an equatorial arrangement of magnetic force, not by the polar one. If it were not so, the black end would point to the surface, but you see how it dips or inclines to the surface. If the earth had a magnetic pole, this end of the needle when suspended vertically would point to that part. The needle, however, points down into the mass of the earth soon after leaving the equator, and follows that beautiful and curious relation which belongs to a single wire, when the needle is carried round it. I have put up a rude diagram to illustrate this. Suppose this were a part of the earth, and that were a bar along its polar axis, a magnetic needle at the equator would stand parallel to the horizon. A little further on, where our latitude is, it would lose the horizontal line, and begin to dip until it stood vertically. You will see the difference if I take an arrangement of wire which is supposed to send electricity round the earth in place of an internal magnet. The needle stands parallel to the horizon: it soon dips when we get to our latitude: it dips in this shape: when you get nearer the astronomical pole, the pole of the earth, it dips very much; but the dip is much more rapid if you assume the magnetism of the earth to depend upon these currents running equatorially, than if you suppose it to depend on the polar axis. Instead of the poles being at the extremities, they must in reality lie close together at the *centre* of the earth.

But whether the mangetism of the earth be due to currents running round the earth, or to a magnet fixed in the axis, the effect on these bodies is precisely the same; and all substances placed in a line—and if placed in this room in relation to the rope before me—would be affected in the same way as diamagnetic bodies; that is to say, precisely the reverse of the needle. The slice of apple, instead of pointing axially, points equatorially.

Now, I must briefly conclude by saying that if you consider, from the experiments you have seen, that all the oceans, rivers, and lakes,

on the earth, are diamagnetic, that all things are either indifferent to the magnetism of the globe or influenced by it, that all the rocks and strata not containing iron are diamagnetic, that if a little statue of Carrara marble were placed between the poles of this magnet, it would point east and west; if a man were hung up here he would point east and west, and that we ourselves are affected by the magnetism of the earth, although in a very slight degree: speaking as to measure, we are affected by laws that permeate every part of the earth: we cannot believe it to be possible in nature that these things should take place and result in nothing. Nothing is unproductive in nature, there is no residue of action that is useless. We have often been deceived in our experiments—we do not know how; we often find action taking place, and we do not know the cause; we sometimes see phenomena, and cannot trace them through; but never, when we are able to trace them, do we find the least surplusage or deficiency in the amount of power or effect. All the power that God has infused into matter, He uses for various effects in creation. It is impossible to know, as we feel we do, that the earth's power as a magnet can be permeating all these things, and all living systems, all animals and vegetables, living and dead, and leave them untouched or unaffected. I have not the slightest doubt that we shall hereafter find what kind of action this is, and what part it takes in organic and inorganic matter. I think I see already the mode in which magnetic action travels through bodies. I showed you that it goes through water and flame; I think I see how it goes through them by virtue of this diamagnetic condition. I think there is a chance of finding out that the magnetism of the earth may have some relation to the sun, because we have ascertained in some degree a certain relation of light to magnetism. Although it does not come to much in filling up the whole system of things, yet it affirms a great fact, in opening a new door to phenomena of different kinds. When we see that our atmosphere is such that it can become either diamagnetic or magnetic, when we see that the atmosphere is related to the earth beneath and the sun above, and that all these bodies have their magnetic relations, we cannot but think that this power is designed for some high and important purpose. As regards the amount of power, though small, it is enough for our purposes; and is, no doubt,

greater as regards the globe than the gravitation which this mass can exert on the substances around. If I were to repeat the experiments of Cavendish and Baily, I should see no such power there, as in this magnet, and that slice of apple. I can hardly measure it by a delicate arrangement, but I can measure magnetic force, and that by rough means compared with what Cavendish and Baily used; and you see how it can be raised to a high degree far surpassing gravitation. When we are engaged in the pursuit of science, as I said before, you must suppose that our tendency to know all things makes us hope the more, when we find that a new door is opened to us, and that we touch upon a chamber so large, but hitherto concealed. In such expectations we are never disappointed; we may often take a wrong way, but we never fail to find, in the end, new riches disclosed to us.—*From the London Medical Gazette.*

Extract from the Diary of Major Marshall, *when on Leave of Absence in the Himalaya, A. D.* 1827.

March 11*th.* Moostufabad—10 coss. When within sight of the place, found our tent and baggage on the bank of a rivulet, which was so swollen by the rain as to be impassable. Breakfasted on the bank, and by noon the stream was so much gone down as to admit of our baggage passing. Atmosphere clear and affording us a distant view of the mountains. Three ranges—the snowy range raising its huge white caps to the clouds; on the second, there seems to be a partial covering of snow; the third, appears in comparison extremely low. On this some white houses are plainly perceptible, which we suppose to be Nahun.

13*th.* Nahun—8 coss. The road very difficult for our horses. Met two men with each a couple of pieces of sandal-wood, they expected to get four annas each for their loads. Our baggage was brought upon mules and coolies. Our road this morning was very steep, but wide and firm, having just been repaired by the Rajah of Nahun. The prospects were sometimes beautiful. Deep dells full of beautiful trees of every shade of foliage, close under us, with mountain streams dashing along their gloomy bottoms: sometimes we had a fine view of an undulating valley, and at others we beheld the

plains extending as far as the eye could reach. The bamboos were very plentiful, and we observed many fir trees about Nahun. We saw an animal like a pole-cat, about a foot long, with tail of the same length, and somewhat bushy. The head sharp, like a fox's, and nearly black. The tail and upper-part of the body black, the lower part light coloured. When shot at, it jumped from the top of a tree to the ground, and was making off, when caught and killed by the dogs. Saw a species of pheasant; shot one, in shape like the English, white plume on the head, red about the eyes, but without any beauty of plumage. Saw several wild cocks and hens, much like the domestic, but could not shoot one. We have a fine prospect: on the right and left hills and valleys richly clothed with trees, and in front the town of Nahun at our feet, over which the tops of a few hills, and beyond those an immense extent of plains. The Rajah has a large palace of stone, plastered with white chunam, and finely situated. From this the town extends along the brow of the mountain to a rising ground on the right (on which is a Thakoor Dwara or temple) occupying a small plain. The place is of a respectable size, and has a good appearance; the houses being chiefly of stone, faced with white chunam, with flat roofs, very neat outside, and apparently clean within. The bazar is very good and paved. There are two tanks, but the water is neither very deep nor pure: close to one are the tombs of four officers killed in the retreat from Jythuck, a hill fort about four coss to the north, in an attack on which our troops were driven back by the Goorkhas, in A. D. ——. There is also a handsome stone obelisk to their memory, but without a tablet or inscription, though there is a place evidently designed for the former.

15*th.* Thermometer 59° at sunrise. Walked out with our guns to a forest of firs. They seem to be of two kinds: one, the trunk of which is straight and tall, and devoid of branches to some height, when they spread out considerably: the other species is smaller, the foliage richer, commencing from near the bottom, and ending in a conical form; the latter I have seen in Meeruth. Found no game.

17*th.* Muheepoor—9 coss. The road appeared to us difficult, but we were told it was nothing in comparison to what we should see

further on; the coolies seemed rather distressed. A Puharre, or hill man, will carry nearly a maund for a moderate stage with ease, slinging the load on his back and passing his arms through two strings properly arranged. Half of ours were Desees, men of the plains, or rather of the lower hills, and carried their burdens on their heads, these were dreadfully harassed. Our baggage consisted of a hill tent, with one fly and two shouldarees, and about twenty patarrahs among three of us. Breakfasted at a Hindoo temple (four coss), on the top of a hill, in sight of Nahun. Had a distant view of Jythuck, which appears a small fort. The country began to assume a very interesting appearance, the mountain scenery, becoming very grand. The foliage is very thick and beautifully varied: there was not much cultivation, but the patches here and there were exceedingly pretty. We proceeded a considerable distance along a clear stream, which we had to cross about a dozen times. The raspberry and cranberry were very abundant, and we saw a few cherries. We crossed a rivulet called the Jullal, and then ascending about a coss further, reached our halting place, which is the capital of a district under Nahun, called Syne, a little before sunset. This district is accounted very fertile, and certainly had that appearance. The fields are generally terraces on the sides of the hills, supported by stones and small hedges: occasionally we saw a plain of a few acres. On coming to our tents, we bathed in a fine clear stream, which, a little lower, forms a beautiful water-fall.

18*th*. Seyoon—4½ coss. Breakfasted under a large willow near a stream at two coss, after descending some distance on the far side of the Syne range. On approaching the top we heard some chukores cry, not far from us, but could not get a sight of them. The pass on the top was very craggy and romantic, and afforded a grand view of the tops of Choor mountain, partially capped with snow; and the other mountains gradually sloping towards the Girree river. Met a man attached to the Botanical Garden at Saharunpore, and employed, with many others, in different places on the hills in collecting plants. Thermometer at noon under a tree, 71°. Proceeded at about 2 o'clock, and soon had a view of the Girree, with a stream falling into it from the direction of the Choor: a fine view of steep mountains sloping down to the edge of the river, which we reached after a long

and tiresome descent. The stream is from thirty to forty yards broad, and at the ford as deep as a man's legs, flowing very strong, and in many places rushing with impetuosity among the rocks. Crossed to the village of Syoon, which is close to the river, and inhabited entirely by Brahmins. The houses are many, two-storied, with a wooden balcony to the upper one. The temple dedicated to Mahadeo was of three-stories, and the woodwork rudely carved. The people seemed suspicious, and not at all pleased with our visit. From this place there are two roads to Kotegoor, our destination ; one by the Choor and Jullal, which was described as very difficult, and the other up the Girree, more easy and direct ; we chose the latter. Caught a Mahasair fish, weighing about two seers.

19*th.* Mangur—6 coss. Crossed the river again a very short way up, at a ford up to the knees. Proceeded along a pretty good path on the west bank, at the foot of high and woody hills, sloping on both sides with a steep descent to the water's edge. Saw some ducks in a pool of still water. S—— and I, both fired just as they were rising ; and knocked down one, which however contrived to get again on the wing and fly to the opposite bank. Breakfasted half way near the river. Thermometer at noon 71°. Continued to advance up the Girree which we had again to ford. The river began to appear much smaller. We at length quitted its bank, and about a coss after crossing a stream, called Marnyoor, reached our tents. The village consists of 8 or 10 upper-storied houses with balconies. The situation is hot, being surrounded by mountains. The Zumindars complained of being very poor, and they seemed to have some difficulty in procuring supplies for our people and ourselves, in all about twenty. They grow turmeric—walnuts and apricots are also produced : we procured some of the former of last year's crop.

They keep a great many goats and sheep. The latter are large and like the English. They call them Kadhoo, which name they do not give to the sheep of the plains, calling them Bheree (their name in Hindoostanee), nor will they eat the latter. We purchased a lamb which was pretty fat and well-tasted.

21*st*. Kote—4½ coss. Followed the course of the rivulet, in some places bridges were made of a few branches and stones. Therm. at sunrise 49° : noon 79°. The Rajah of Nahun takes his revenue from

this district in kind, and has here a granary, where it is deposited; the grain, but especially the rice, which is very fine, being afterwards taken away for his own consumption. We bought some potatoes grown by a Zumindar of a neighbouring village, who had procured some from Sabathoo. They are scarcely ever grown in these hills, though the soil would produce them.

22nd. Nyrah—5½ coss. Ascended for about five coss (the longest and steepest ascent we have yet had), before breakfast, passing through a wood of stunted oaks (Bān); the leaves, small, and sharply indented. We also saw several holly bushes, and there was a great quantity of a large red flower. The fir is becoming common. Had a fine view of the Choor, and also saw the plains distinctly. Therm. at sunrise 54°: at noon 76°. The latter part of the road even: descended to the village of Nyrah, a larger place than any we have yet seen. The houses are about 50 in number, large and well built of stone, with occasionally a row of a very hard wood (Kellyon, larch), running along the whole length; nearly the whole are two-storied. In the lower story are kept the cattle, in the upper the people reside. They have sloping roofs covered with large planks of the cedar fir (Ruho), procured from the Choor and over these coarse slates. They told us that the snow falls here during four months, and that sometimes it was four and a half feet high, and remains on the ground ten or fifteen days. They have none of their sheep here at present, having sent them all at the commencement of the winter to Syoon, on the Girree. Their milch cows they keep always shut up in the lower stories of their houses, never letting them go out on any account; feeding them on grass in summer, and leaves of oak in winter. Our flock, but especially the goats, were affected with a violent vomiting, occasioned by their eating a shrub which grows about here, which was pointed out to us by the Zumindars, who call it "Oowar." They gave them water, which cured some of them. Here, and all on this side of the Girree, the custom of polyandria prevails, and also infanticide. The female children, when numerous, being put to death by giving them opium, as soon as born. They give poverty as the reason for these practises. The women pretty; a family of several brothers have one wife in common, and the children call them all father. The Syana or headman and the Zumin-

dars told us that it was impossible to ascend the Choor at this season, on account of the snow; we were therefore obliged to give up our design, and content ourselves with a good view of this peak which is the highest point of the second range, being more than 12,000 feet above the sea: on the loftiest part, the snow lay in a large sheet, and lower down it appeared thick among the trees for a considerable distance. The whole of Choor is covered with a forest of trees of the largest size. The larch (Kellyon), the fir (Chur), the cedar (Ruho.) We procured here a little honey of a strong but not unpleasant taste. Towards the evening a cloud overspread the Choor, and we were told that it was snowing. The thermometer, which a little before had been 76°, fell suddenly to 58°, and remained so till sunset.

23rd. Shmoga—5 coss. Thermometer sunrise 43°. The road alternately ascending and descending. The ground beneath sloped abruptly, and in some parts nearly perpendicular to the depth of from 300 to 500 feet. It was rather trying to the nerves at first, as one false step would, in all probability, have been fatal. Therm. at noon 65°. Ascended to Shmoga, an indifferent village. The people on this side of the rivulet frequently fought with those on the opposite side, and there are very high houses in some of the villages (which they call towers), which served as a kind of citadel to retire to, when attacked. These feuds formerly common, have entirely ceased since the British influence has prevailed in this country. The inhabitants of some villages at the bottom of Choor, beyond Nyrah, were refractory last year, regarding the payment of revenue, and the Rajah was obliged to come and settle the affair in person: it did not get to blows. They have wolves and bears here. The latter attack a man if he come suddenly on them or molest them. One Zumindar mentioned that his father suddenly met one on the road, which severely clawed his head, and left him senseless on the ground. He was however brought home and recovered. Close to the village there is a solitary Kellyon or larch, the first we had an opportunity of approaching. It was a grand tree, though small of its size. It is devoted to the god Shiva, whom they call Sirgoon. The villagers offered to show us some game, and we went out with our guns in the evening. Two chukores rose out of a cornfield, and we each knocked down one to the great surprise and admiration of these hill men. We saw three or four more

birds, but out of shot : they told us on other days they had seen twenty together. The villagers showed a very frank and friendly disposition towards us. One was a remarkably handsome, tall, and well made young man : the people we have as yet seen have nothing of the Tartar countenance : their features are not so regular as those of the Hindoostanees, and in person they are shorter and stouter.

The country here is less fertile than that we have as yet seen ; the crops are thinner, and not so much advanced, the ear being far from full. Thermometer at sunset 67°.

I saw some little sheds at short distances from one another over a little stream : within each was some grass spread, and a small hole made behind. To these places the women bring their children whom they lay on the grass, conducting the rill on the top of their heads, the water falls then into the hole, and is conducted to another shed underneath. This operation is performed for the purpose of cooling the children and putting them to sleep in hot weather, which latter result, I understand, it effectually produces. Saw the first red thistle : found and shot three woodcocks in some willows and marshy ground near the bed of a rivulet. Left the dominions of the Rajah of Nahun, and entered those of the Thakoor of Barsun.

28*th.* Synje—7 coss. Thermometer at sunrise 46°. Saw some deer, called Gholes, of a dark red-brown, at a great distance. They appeared darker and larger than the Kakhur. These animals generally frequent the highest and steepest hills on the banks of a river. These when fired at, dashed over the Girree, on the banks of which we again found ourselves. Saw some black partridges. Breakfasted at four coss : passed through the village of Baruk, where is a very ancient temple, dedicated to Suda Shiva. The form was the same as that of the temples in the plains, with the addition of a wooden roof. Crossed a stream a little above its confluence with the Girree, and soon after forded the latter at the foot of the hill on which stands the village of Synje. Thermometer in tent at 4 P.M. 71° ; at sunset 67°. This is the residence of the Ranah of Theog. His is a large house, but the rest of the village is miserable. We discovered we were within three coss of Theog, which is on the high road to Koteghur, and that some inhabitants of this part of the country who were with us, and wished us to go by Koteghur, knew nothing of the road.

Determined to get upon the Suruck or made road, as soon as possible.

29th. Muttyana—9 coss. Thermometer at sunrise 50°. The road was very pretty to-day, being skirted with firs, larches, and other trees. At Nagkundah there is a good bungalow, and here a grand and extensive view opened upon us of the great Himalaya range, raising its huge peaks, the abodes of perpetual snow, in fantastic shapes for an immense extent before our eyes. To the grandeur of the scene was added the pleasure of beholding so near us the great object of our journey, which was to visit these stupendous mountains and the countries beyond them. Nagkundah is a very fine situation. In the rear the view is bounded by the snowy top of Choor, and on the right is the mountain of Huttoo, above 10,000 feet high, which is also crowned with snow at this season. We had an invitation from Lieut. Gerard, commanding at that post, to pitch our tents near his house. Found the Rajah of Bussahir encamped near a village on the road, to the house. He was on his way to Simla to meet Lord Amherst, and hearing that the small-pox prevailed there, had been getting himself vaccinated by Dr. Wilson, on a visit at Gerard's: he is about 19 years of age. Kunawur, the country in which we are going to travel, is a grand division of his territory.

4th April. Dutnuggur—9 coss. The weather, which for the last two days had been rainy, cleared up, and we started in the afternoon, descending rapidly nearly the whole way to the banks of the Sutledge, on which Dutnuggur is situated. It was evening before we arrived; but the place was very miserable, and not worth seeing. The change in the state of the corn in our descent was remarkable: the barley which was not in ear at Koteghur, we found successively as we got lower, first in full ear, then partially yellow, and at length on the banks of the river, quite ready for cutting. We observed some apricot trees, with fruit as large as almonds. The Sutledge does not appear more than forty yards across, but it is very deep, and rushes along with great rapidity: making a tremendous roar when occasionally interrupted by large fragments of rock.

5th. Rampoor, 3,389 feet. We walked to the place, where in the rains, when the river is high, a jhoolah is erected for crossing the stream. It is about seventy yards wide here. A buttress is raised

on each bank, with a post, to which a rope is fixed and stretched across; on this runs a machine of rope with a noose, on which the passenger places his feet and clings, being dragged across by men stationed for the purpose. This perilous bridge has been removed for the present, the water being low; and the people cross by another plan equally curious, viz. on the inflated skin of a bullock, upon which the ferryman places his breast, striking with his feet, and using a small paddle with his hands. One man we saw cross, carried the boat on his back when he reached land, which had a curious appearance, the skin of the head, legs, tail, and ears of the animal being all perfect. He appeared to advance with ease against the stream near the bank, and to swim with great strength; being very little carried down, even in the centre, where it ran very strong. Sometimes a passenger or two cross besides the man impelling the hide; occasionally with loads on their backs.

9th. Goura Kothee—5 coss. Proceeded for a coss close along the Sutledge, to a point where it rushes through deep and perpendicular banks of hard rock, about thirty or forty feet across; and the stream being interrupted in the centre by large white rocks, resembling marble, makes a tremendous roar. From this place there commenced a steep ascent, which continued to our breakfast ground, three and a half coss. We soon rose to the region of the fir and the rhododendron, and had a view of snow. Thermometer at noon under a rock 67°. Still ascent then descent, and again an ascent brought us to Goura Kothee: here is the storehouse of the Rajah of Bussahir. There are a few houses and a temple, and a respectable village a little further on the road, called Dhar.

10th. Surahun, 7,248 feet—5½ coss. Thermometer at 7 A.M. 56°. Our road was through a fine forest of larches, firs, and oaks: principally a gentle descent. Many of the oaks were covered with ivy, which seems to be partial to the tree, as the white rose, which grows to an immense size, appears to prefer the Kellyon or larch, sometimes spreading itself entirely over a very tall tree. Descent for a short distance, then a long ascent to the top of another range, when we had a sudden view of Sooran, situated in a hollow in the mountains at our feet. This is the summer residence of the Rajah, and his house has a pretty appearance. It is about 7,200 feet above the sea, a good

sized village, and we saw several other similar ones in the neighbourhood. Soon after reaching the tents, the clouds collected on the hills around, which are greatly higher than ourselves, the tops being thickly covered with snow, and we soon had some light rain, which increased towards evening. Thermometer at 4 P.M. 55°. The weather cleared up in the forenoon, and the villagers, on account of some festival, decked with rhododendron flowers, the tops of several Kellyon trees, of which the branches and bark, except near the head, were cut off. These were placed erect near some of the houses by ropes, also decked with flowers, and a very tall one was planted in front of the temple of Bheema Kalee, in whose honour the festival, I believe, is kept. In the afternoon the clouds again collected, and rising in thick masses from the bed of the Sutledge below us, spread themselves over the mountains on which we were. The snowy mountains opposite were also covered with thick clouds, and we had constant showers of rain as each cloud passed over us.

14*th.* Tranda—4 coss. Height 7,089 feet. Thermometer at 7 A.M. 51°; at 10 A.M. $58\frac{1}{2}$°. This was a short march. Before reaching Tranda, there is a fine grove of large Kellyons, one which was above twenty-five feet in girth. These trees, when old, appear to lose their fine tapering tops, having usually a row of branches spread out at the very summit, flat like a table: close to the village is a large grove of pear trees. They were in blossom: the villagers said that the fruit did not grow large, and became of a blackish colour when perfectly ripe. They dry it and grind it into a flour, which they eat mixed up with water. They say they are badly off for flour, and supplied us with difficulty. We are now in the district called "Uthara bees," the language is the Milshan, which is also the language of the opposite side of the river, called the "Pundruh bees," and prevails throughout Kunawur.

In one place the earth had given way above the road, above a stream; and had precipitated itself apparently the day before into the torrent, leaving a large cavity. The road was lined with fruit trees, wild peaches, apricots, pears, and a tree they call Syngool, with blossoms like the pear, but the leaves very different: approaching Soongra, there is a curious and large Kellyon tree, near a Chinese-looking temple, which after rising in one high stem a few yards, separates into

two, one of which some yards higher, throws out a branch, which enters the other, forming an arch. There are several other branches, eight or ten, shooting out horizontally a few feet, and then rising up perpendicularly to the height of a moderate tree: near to this is another tree of an enormous size, something like a chesnut, which they call Hoondool.

17*th*. Wangtoo bridge, 5,200 feet. The made road ceases, and we were soon made sensible of its loss: our path on leaving Soongra, passing along the side of a mountain, and being in some places nothing but holes for the feet for several paces, into a nearly perpendicular rock. I found all my nerve and steadiness requisite to enable me to preserve my footing. It was surprising to observe with what ease and unconcern the hill men proceeded along, hopping from one point to another, without employing their hands to assist them.

The people here brought us the skins of three curious animals, with a skin or membrane, covered with hair like the body, extending along the leg to the foot, and uniting the hind and four legs. Two of them were about eighteen inches in length, with a bushy tail, nearly a foot long. The head sharp, and the hair a soft fur; greyish-brown on the back, and light under the belly. The feet black and small, and furnished with claws.

The third was of the same description, but of a grey colour, and not half the size, with a thin tail. The villagers told us that these animals fly, or rather float, through the air from tree to tree, with the help of the membrane by their sides, to the distance of nearly a hundred yards. They call them Ain, and say they live on the leaves and fruit of the trees, appearing only at night. One of the villagers had a young Moonal, it was of a dark brown-grey. We procured here some of the best walnuts I ever tasted. Thermometer at 9 A.M. 56°. A considerable descent brought us to our tents which we found pitched in a grassy spot, surrounded by huge crags, close to the bridge. This bridge which is of wood, and called by the natives a Sangool, crosses the Sutledge, at a point where it runs through a bed of rocks, being about thirty yards across. There is a buttress or pier-head on each bank, from which project three rows of large trees, each a few feet farther than the other, and sloping upwards to the distance of about thirteen feet. On the ends of these, which are

about twenty feet apart, are laid two stout Kellyons, three feet apart, and the whole is covered with good boards, all being well fastened down with stout iron nails. The span I should think about forty yards, and the height from the water nearly as many feet; and though of such strong materials, the wind, which is always high, causes the centre to spring up and down. There is a railing on each side, but in bad repair. Formerly there was a jhoolah here, and the bridge was built at the recommendation of our Government, which defrayed half the expences. Thermometer at 3 P.M. 67°. In the evening we caught some fish in the Sutledge, the largest weighing about a seer, of a light colour, with small scales; the flesh is darkish, and very poor-eating. Thermometer at 9 P.M. 56°.

18*th*. Chigown—6 coss. 7,225 feet. Crossed the bridge to the right, or north bank of the Sutledge. The road was at first an almost perpendicular ascent to the top of a craggy mountain, and then a gradual descent along the opposite side down again to the Sutledge, near which we breakfasted. Thermometer at 7 A.M. 56°: at 11 A.M. 71°: continued along the bank of the Sutledge. The road very bad, for the most part on slippery rocks, and the latter part a fatiguing ascent. The heat was dreadful: the rays of the sun being reflected by the rocks. Thermometer at noon 76°. This village which is called by the Kunnowrees, Tholung, is large; but the houses are scattered over the face of the mountain. The ground appears fertile; the crops of barley being very thick, but there is little or no wheat. The walnut trees are particularly fine, and with the numerous apricot trees in the place make it look like a large orchard. We took up our quarters as usual near one of the temples. Mahadeo is the deity worshipped here, and the principal temple is a wooden building in the Chinese style. In this village the Rajah, then a child, with his mother and the hereditary Wuzeers, resided when the country on the other bank of the river was conquered by the Goorkhas. The invaders were unable to cross the river, the bridge at Wangtoo having been destroyed. Therm. at 4 P.M. 67°: at 6 P.M. 65°: at 9 P.M. 63°. Many of the houses here have flat roofs, formed of wood-work, covered with bark of the birch and earth over all.

19*th*. Chigown. Our baggage was on the point of starting, when we were informed, that the road we had determined to proceed was

blocked up by the snow, which fell on the 15th and 16th, having been before open. There is another route crossing to the left bank of the Sutledge here, and after proceeding two days along it, recrossing to the right bank, but we had seen enough of the rocky edge of the river, and we thought it advisable to halt a day at least to enquire into the matter. Thermometer at 6 A.M. 60° : at 11 A.M. 63° : at noon 65°. We are surrounded by snowy mountains, and the Shatool and Brooung passes are no great distance from us, the former SW., the latter South. This place we find warm or rather close, being on the face of the hill, and the wind completely excluded by the mountains overlooking it. The cultivation around is very strong and healthy, and they have a custom, where the ground is particularly productive, of building a pillar in the middle of it, plastered white with some loose stones on the top, with the idea, I was told, that the ill effects of the praises of passengers whose attention may be attracted by the goodness of the crop, will fall upon the pillar, and be averted from the grain : the people here, believing with those of the plains, that admiring an object entails mischief upon it, or that certain persons have an evil eye. There is a great quantity of wild garlic had here. I went to the temple of Mahadeo, in which is a curious image of that deity. The upper part is a cylinder, I believe, of wood, underneath, divided into fourteen or fifteen compartments, in each of which is a head of gilt brass, in relief, about the size of a man's hand, raised on a silver ground. They are all similar, and have a kind of mitre. The ears are of silver, with ear-rings of the same, and both very large. The execution is better than any thing of the kind I have yet seen. There are only three faces visible. The lower part which is of wood and thicker is covered with stuffed silk, and on the top of the whole is a large bunch of the hair of the cow, called Chuor Gao, of a brown colour. This is called the Rajah's deity, and is occasionally carried to Rampoor or Sooran to visit his Excellency. There is another image of the same kind, but inferior, in the same temple, which is called the village deity. They have some cattle here, the offspring of a cow of the country, and a bull of the species called Chuor Gao (Bos grunialis) from Chowrees or fans for driving away flies, being made from their tails, the hairs of which are remarkably long. This half-breed is called Zō, they are fine large ani-

mals and have the peculiarity about their tails in some degree, and very long sharp horns like Irish cattle. Thermometer at 4 P.M. 67°, at 9 A.M. 63°. Resolved to halt here till the road is open as far as Pungee, three stages hence, and then to proceed thither as it is a large village, where we could procure supplies for a few days, should it be necessary to remain: and its situation is lofty. Thermometer at 6 A.M. 60°, at 11 A.M. 65°, at noon 67°. There are a great many Chukores about here, and a few pheasants.

21st. The females here appear much afraid of Europeans—most of those I saw appeared very ugly. Woollen is the only wear above Koteghur. The men wear trowsers, a kind of coat or shirt, a cloth folded round the waist, shoes, the tops of which are of worsted knitted, and a low circular cap generally black or brown with a fold round the bottom, something like a turban. The ladies wear a piece of cloth, covering the upper part of the body and fastened in front with a large brass pin or rather broach, which is a conspicuous ornament hanging in front, and being composed of two bits of brass, as large as the hands joined together, and having a pin fastened to them, in the manner of our broaches. Their hair is plaited behind, and fastened across the back of the head in a large roll, ornamented with two great bunches of red wool, which look at a distance like Rhododendron flowers, and their cap is the same as that of the men with the exception of the cloth on the top being red. This head-dress, when well adjusted, appeared to me becoming. Thermometer at 10 A.M. 65°, at 11 A.M. 65°, at noon 67°.

22nd. Meroo or Mirtung—5 coss, height 8,550 feet. Soon after leaving Chigaon, I heard a loud and continued crash, and on looking round I saw a number of large stones rushing down the slope of the mountain I had just passed: H—— who was behind had to run to escape this avelanche. They frequently occur after rain.

There are a few stunted oaks before coming to Oorunnee, the first forest trees we have met since leaving Wangtoo bridge, though the opposite bank of the river is covered with large trees. The country becoming not quite so bare as before. I saw one of that species of fir which bears the Nyoza nut, and which is plentiful above this. It differs from the common fir in having its stem and branches crooked, and its bark smooth and of a light mottled colour. Meroo is a

wretched village, yet it had two or three temples, as appears to be the case in almost every one, and we were lodged in one of them, which was smaller than usual, but much better than a tent. Therm. at 3 P.M. 60°, at 5 P.M. 59°, at 7 P.M. 57°, at 9 P.M. 57°.

23*rd*. Rogee district, Shooal—7 coss, height 9,096 feet. Therm. at 6 A.M. 53°. The country very craggy yet not without wood. Our elevation is becoming gradually higher; and we breakfasted near a precipitous torrent, on the banks of which were large masses of snow, and just below us there was a natural bridge of that substance, formed probably by an avalanche. After breakfast we had a long ascent up a steep mountain, and then to pass along its face, passing over some large sheets of snow, the depth of a man's waist, but hard enough to allow us to walk without sinking. This snow was melting, and the water running down loosened the stones and rubbish which kept up a constant clatter, but the hill not being very steep just here, it did not produce any effect. After gaining the top of this mountain, we had to go down the other side of it in a diagonal direction to Rogee, meeting with another large sheet of snow. On the opposite side of the river I observed the track of an avelanche. The snow appeared to have given way about the middle of the mountain, and to have swept every thing before it for a considerable breadth, till it reached the Sutledge, on the edge of which it lay covered with earth, trees, &c. Rogee is a poor village, and they have but one temple, so that we could not be accommodated; and for want of room elsewhere, we were obliged to pitch our tent on the top of an empty house in which our baggage was deposited. It appears, that the second temple we observed in each village, is only visited by the deity on great festivals, when he is carried thither in a kind of palankeen. Here is also frequently a little open wooden house in front of the temple, in which the idol is sometimes placed. There was a family close to us, in which there were two very good-looking girls. The eldest was a tall and really elegant figure. They appeared clean and respectably dressed (a rare thing among the females we have lately seen), and modest without being so ridiculously bashful, as we have usually found them. Grain is becoming very dear. They would not give us more than 16 seers of wheat-flour for a Rupee, and 20 seers of barley. They make no difference between the price of grain and

the flour, giving as much of one as the other. Therm. at 7 P.M. 59°, at 9 P.M. 57°.

24th. Cheenee—3 coss, height 9,000 feet. Thermometer at 6 A.M. 49°. The Begars (porters) not being all ready we took breakfast before we started, the march being short. The road was good, the temperature pleasant, and the scenery fine. The pure snow which covered a lofty range in front of us, glistened beautifully in the clear sunshine. A small torrent we crossed had a high wall of snow on each side, some yards from its bank, which it had probably brought down from above, and here thrown up on its banks. The ground near Cheenee is rather more level, and there is one field close to it of about two acres, the largest piece of level ground we have seen since leaving Koteghur. The situation is very good, and the scenery grand; but the village itself wretched, and all the houses going to ruins; we first got into the shed in front of the temple, which we fitted up with kunauts, but not fitting very well, they did not exclude the weather, which was becoming stormy. The Mookhya shewed us a house which had been occupied by a Mr. Walker, and was one of the best, but it was so dark and filthy, we preferred pitching our tent. The evening was very chill and cloudy, and we had a shower of rain after going to bed. Thermometer at 3 P.M. 63°, at 9 P.M. 53°.

25th. Pungee—4 coss. Thermometer at 7 A.M. 49°, at 9 A.M. 55°. The rain having wetted the tent we took breakfast before starting. Just after quitting Cheenee, we came to a fine grove of Nyoza firs, from which we had a most interesting prospect. The ground in front of the village, for the extent of two or three miles, is pretty level, but divided by the terraces into fields of sometimes a very respectable size, which division gives it a diversity, and supplies in the prospect the place of enclosures. The land is well cultivated, and prettily studded with apricot trees in blossom, but not in foliage, and some firs, with a few flat-roofed and neat looking cottages scattered over it. This peaceful scenery is bounded, and finely contrasted by the stupendous mountains, which rise like an amphitheatre in front, and appear at no great distance; their rugged sides blackened with large forests of every species of fir, up to what is apparently the boundary of vegetation, and their peaked tops covered with the purest snow, which extends in huge fields, on which the beholder gazes in admira-

tion till his eyes are tired: nearly the whole road was through a forest, and on approaching Pungee we descended to a torrent, crossed by a bridge. A pretty steep ascent brought us to the village, and we found S—— in his tent near the temple, which, however, proved to be very good quarters, being raised, and having a very comfortable room, fourteen feet by ten, and a balcony in front nearly the same size. A man we sent to Rampore from Chigaon on the 19th, with a letter to Gerard, overtook me with the answer on the road to-day, having been six days in performing a journey of above 150 miles.

26th. Pungee—halted; H—— not well. This place is situated on a declivity, and consists of two villages, one above and the other below, about half a mile asunder. The lower one is largest, and is of itself considerable: in the upper one was our lodging; they are both filthy. The neighbouring fields are thickly studded with poplars and peach trees, and there are some vineyards, which are said to produce very good fruit. The mountains which above the higher village becomes more steep, is covered with a forest of larches and Nyozas to a considerable height, when it concludes in a lofty perpendicular narrow rock which forms a singular screen to the rear of the village. In front (south), are the Raldang mountains, one of the highest peaks of which appears on this to be a perpendicular rock, and, no snow of course lying on this side, you can perceive the thickness of that on the top, which is a level. On the left (east) are mountains apparently still more lofty; and on the right is a range now covered with snow, but which melts in the hot months. In the month of June, the villagers all proceed to the top of the stupendous crags in rear of the place, where they celebrate a festival which occurs then, and pile up stones, for what purpose I cannot say, on the edge of the precipice, which are visible from the village. There is a Lama here, but we had not the pleasure of seeing him; and there is, in some places, a kind of large rude urn of stone, plastered and painted, something like tomb-stones, under sheds, put up by the Lama priests, and devoted to some deity with the intention, I believe, of making him propitious to the crops. At Cheenee there are three of these under one shed. We had some slight rain in the evening. After dinner we heard a loud and continued crash of stones falling down the mountain, at a place about three or four

miles on the road on which we were to proceed. Thermometer at 4 P.M. 57°, at 7 P.M. 54°, at 9 P.M. 54°.

27th. Pungee. Thermometer at 6 A.M. 52°. On account of the rain we had determined on not marching till after breakfast; but we were told that the part of the road where we heard the stones falling last night was dangerous after rain, and that it was safe to pass it early in the morning, before the sun had strength to melt the snow, which loosens the soil, and occasions the stones to give way. We determined to halt another day. This we did on account of the porters, who, the day being already advanced, could not have passed the spot before noon. S—— and I walked down to the lower village, which we found a perfect pigstye, and we went to a small vineyard. The plants are supported by a kind of trellice, but were not yet even in leaf. We saw a decrepid old man nearly blind, with a straggling white beard, who told us he was 120 years old, which was a *thumper,* and while we were speaking to him, his wife, a strapping old dame, came out and politely asked us to smoke some tobacco. On our saying we did not smoke, she took a wooden vessel, like a quart measure in England, and brought it to us full of raisins as a present; they were dirty looking things, and we gave them to an attendant, putting a couple of Powlies into her mutchkin in return for her kindness, with which she seemed highly satisfied. She abused the Hills, which all do, calling them a Kāphir (Kafir) country, producing nothing. She spoke a little Hindoostanee, learnt at Rampoor, denoting by horrible gestures and grimaces what she could not otherwise express.

28th. Rarung—5 coss, height 9,022 feet. There are two or three roads from this to Soongnum; the shortest is over the Rooring pass (14,000 feet high), but that is, at this season, impassable. We took a lower road which is good, but round about. Being anxious to pass the spot where the stones fall, before the heat of the day, we resolved to breakfast at Rarung, and not half-way as usual, as the latter plan would cause a delay. About half-way it began to rain, and the shower continued sometimes heavy, for above an hour. This was peculiarly annoying, as it was just the thing to cause the stones to fall, which we had been so anxious to avoid. We however passed the dangerous spot, which was about 200 yards broad, all safely. Huge

fragments of rock were lying in every direction, which seemed to have fallen from a crag at a tremendous height above, down a slope of pounded rubble, along which, though not very steep, they must have rushed with tremendous force, as appeared by the thick branches of a tree which had been recently broken, and the effects of their collision with other rocks lying near the road. The situation of Rarung is pretty; and the stupendous Raldong appears almost to overhang it.

29*th.* Jungee—5 coss. We had breakfast at the village of Ukpa, about two coss, near a heap of stones of an oblong form, four or five yards long, four feet high, and three broad; the top stones of which were carved with characters somewhat resembling Sanscrit, inscribed by the Lamas: there was also a flat stone at each end, much carved. The words are, I believe, the name of the deity. We met two more of these before reaching Jungee, and there are several round the village; they are to propitiate the deity, and travellers walk along them up or down, according to the direction they are going, to insure a safe journey. We met on the road two flocks of sheep carrying burdens, one going down to Rampoor with wool, and the other coming from thence with flour, each sheep carries four batties, or 8 seers. Some will carry as much as 10 or 12 seers. Nearly opposite to this place is a very large and beautiful village, called Ginnum; we heard there were several Lamas here; hitherto we have only seen in the temples men called Poojerees, of the Kunnayut caste, who perform the ceremonies. This afternoon was rainy and uncomfortable.

30*th.* Jungee. The morning was cloudy: we descended close to the Sutledge, and on its bank above passed over an immense mass of snow, which must have fallen from above, though not at any distance. Here it began to rain, and my attendant informed me that there was some danger of stones falling, a piece of information which, had it been given the night before, might have prevented the dreadful accident which occurred afterwards. A little further on, a stream called the Chungtee, falls into the Sutledge. Over the former we crossed by a plank, and found our breakfast things on its edge. We were obliged to pitch a paul (small tent), on account of the rain which still continued to fall slightly, and we were too much occupied in sheltering ourselves and satisfying our hunger, to observe our dangerous situation under two

high crags of loose rock, one on each side the stream. Up one of these the road led, and after breakfast, most of the other people having gone on, the Khidmutgars began ascending, and we moved out to allow the tent to be packed up, when a crash above announced a fragment had given way. Every one immediately fled for safety. S—— and H—— took shelter under the face of the rock, and I being farther out, and seeing the stones coming towards me, ran off to the edge of the stream; we three escaped untouched, being more lucky than an unfortunate Mussalchee of H——'s, whom I saw struck by two stones on the head. The first seemed only to stagger him, the second, a large flat one, struck him with great force, and hurled him down the rock, about twenty feet. On being taken up, he was found to have a slight cut on the forehead, and a dreadful fracture behind. His legs were a little cut, which I believe was the only effects of the fall. He was alive, but speechless, and apparently senseless: we resolved to return with him to Jungee, as the road to Kanum was long and difficult. We accordingly put him into S——'s dooly, binding up his head as well as possible, and hastened back. On arriving at the village, three Lamas came to look at the man, one of them was a venerable looking person, with long dark hair and beard, and dressed in red. They consulted their books, which were printed with wooden blocks, and they seemed inclined to do the man good if they knew. All they could make of it, however, was that the man was destined to die: no great discovery, considering that a large piece of his scull was depressed upon the brain. He was placed in an empty house, and my brother's Bheestie and another man attended upon him. We sent to Kanum for our bed-clothes and some wearing apparel, which arrived before bed-time; and one of the servants cooked us some *chapathies* and *dal*, which, with a little brandy and water, and a few raisins, constituted our dinner. We heard that my Khidmutgar was wounded in the leg and foot, but only slightly. My brother's dog was also just touched, and these were the only casualties: a wonderful thing, considering the number of persons who were underneath the mountain, and ascending the road, which after going forwards a few yards to the left, makes a sudden turn back to the right, and sweeps round the brow of the mountain. There were besides forty or fifty people with loads on their backs, who passed the same way during the day,

besides loaded sheep, yet we did not hear of one being struck, nor of any more stones falling. The poor Mussalchee lingered till night, occasionally groaning, but generally perfectly quiet, and expired shortly after we went to bed. The weather was changeable throughout the day, and we had a little snow. This must be the rainy season in this country. We saw a real Yak, a male of about five years: a very pretty animal, with long hair, especially on the legs and belly; of a grey colour, and a fine bushy tail, he was not quite full grown: larger than a cow of this country, not so big as an English one; fine tapering horns, gentle; led by a string through the nose, stepped out like a horse.

(To be continued.)

Palæornis Nigrirostris.

To the Editor of the Journal of Natural History, Calcutta.

Sir,—It having been asserted by high authority, that the Palæornis nigrirostris of the Catalogue of Nipalese birds (by the way, why was its publication discontinued after about a tithe only had been given?) is the young merely of Pondicerianus vel Mystaceus, I beg leave to state, that one of my servants now possesses a fine living male specimen of either species, and that he purchased these birds respectively three and a half and one and a half years back, when they were fully grown. It is clear therefore, that there can be no mistake about their present maturity. For the last twelve months I have had them under my own eye, and as they are now in high feather and condition, I will give you a summary description of the differences they exhibit in size, proportions and colours.

Mystaceus is decidedly the larger bird, and has proportionally longer and more pointed wings and tail. The upper mandible of his bill is coralline-red, whereas both mandibles are black in Nigrirostris. The pale cap, common to both, is of a purer hue in the latter species. This cap is also smaller in Nigrirostris, extending to a less distance towards the nape, and at the nape it is more nearly divided from the green mantle by the two horn-like lines of colour, which in both species curve more or less upwards from the ruddy front or neck

and breast. Lastly, the ruddy parts just named are deeper and more fixed in colour in Nigrirostris, not variable and shading towards iridescent blue or plum-bloom, as in Mystaceus.

All the above distinctions are very noticeable, particularly so the superior length of the wings and tail in Mystaceus, and his bright coralline upper mandible, though the latter mark belongs only to maturity, and hence room has been afforded to allege a want of care in the original discrimination of the two species. Mr. Hodgson, however, I suspect was sufficiently familiar with the youthful as well as mature aspect of both birds, and with the changes they undergo in advancing to maturity; and at all events, the above stated facts seem to leave no room for further doubt that Nigrirostris is really a distinct species. My servant's birds were procured in the vicinity of the Rajmahal hills, so that these two species would seem to be found in most parts of the continent of India, having mountains in their vicinity; for all the Paroquets love the shelter of hills, and breed there exclusively, though they wander a good deal in the cold season, especially in the plains.

I am, &c.,

AMICUS.

Critique on Dr. JAMESON'S *Zoology of Chinese Tartary.**

In the 27th Number of the "Calcutta Journal of Natural History" was inserted a letter from the pen of Dr. W. Jameson, containing observations on the Zoology of Chinese Tartary, and as that letter contains errors, which if not corrected, might probably, from the writer's position, be received in Europe as facts, we have deemed it necessary to send you a short critique thereon, to which we shall feel obliged by your giving an early insertion.

Dr. Jameson starts for Chinese Tartary, via the Neetee Pass, and finds "limestone filled with organic remains,"—as many other tra-

* Mr. Jameson's observations were only entitled "*Extract of a letter, &c.*" in such communications, style and strict accuracy, are less to be expected than in papers of more pretension. In this point of view, perhaps the critique may be somewhat misplaced, although otherwise perfectly fair, and, in itself, very valuable.—ED.

vellers have done before; we are not told to what formation the limestone belongs, but the author flatters himself that the elevation of its locality, viz. 16,800 feet, is probably the highest at which fossils occur; no reason is given for such a belief, and that probably because none *can* be given; it may very possibly be the greatest elevation at which *he* has ever met with them, but did not Gerard discover fossils at nearly 18,000 feet? We have an idea that he did. The absence of trees and the more rounded appearance of the hills on the northern side of the Himalayas strike our author, as appears to have been the case with every previous traveller, but nothing new is elicited from his observations. We are told, however, that "deep ravines occur, which drain off all the melted snow water." This fact is only novel in so far as regards its appearance among the observations of a scientific writer, but may we be allowed to ask, if "melted snow water ever takes any other channel of escape in other countries? We have always been led in our ignorance to suppose that such ravines were the natural and only outlets for the waters! We should also wish to know, in what respect "melted snow water" differs from "*melted snow*," for if, as we imagine, they are but one and the same thing, we would suggest the propriety of using the latter term for the future, it having the decided advantage of being *English*, which the former as decidedly *has not!*

"The Burhal," called by our author "*Ovis nahor*," in contradiction we presume of Mr. Blyth, who long since called it "Ovis burrhel," (the "*O. nahoor*" being according to him a distinct species, in which opinion albeit we are more than half inclined to coincide) is said to occur on "both sides, being met with in flocks of twenty and thirty from Mulari on the British or *northern* (!) side of the Himalayas, (we have always been under the impression, that we were living on the *southern side* of the Himalayas!) up to the pass, and on the Thibet side it is equally common."

There is another species of wild sheep met with in Tartary which we are informed, is nearly allied to the "*Ovis ammon of Siberia*;" no wonder, seeing that the animals are identical!

The fact of this identity was many years ago suspected by Mr. Hodgson, when resident in Nepaul, and has since we believe, been verified by Mr. Blyth, of the Asiatic Society in Calcutta, and yet our

author, neglecting to make himself acquainted with the labours of Indian naturalists, cannot arrive at any satisfactory conclusion until he has compared the specimen with one in the Edinburgh museum! Here again his meaning is somewhat obscured by the negligence of his style; for he says, the Thibetan animal is allied to "*Ovis montana*" of North America, and to "*Ovis ammon*" of Siberia, and "in fact, from what he remembers (!) of specimens sent to the Edinburgh museum from Hudson's Bay,* he considers the Indian species identical." Identical with what? with "*O. montana,*" or with "*O. ammon?*" not with both of them surely, for they are distinct! unless indeed, on the mathematical principle, "that things which are equal to the same, must be equal to one another," he proposes to double them up all three into one!

Regarding the hare of Thibet, Dr. Jameson observes, that "it is larger than the Alpine hare of England, and is *therefore* probably the largest species known." Had he confined his remark to the simple fact of the superior size of the Thibetan hare, he would have been correct, but why it should "*therefore*" be the largest species known, we are at a loss to conjecture, since so far from the Alpine hare of Britain (not England) being the largest, it is actually, according to the Naturalists' Library, the smallest of the three species inhabiting Great Britain and Ireland! The dimensions given in that work are thus stated:

"Common Hare, *Lepus timidus;*"	*Inches.*
length to end of tail,	26
——————— head,	5
——————— tail,	$3\frac{1}{2}$
——————— ears,	$4\frac{3}{4}$
from olecranon to end of middle hind-claw,	8
heel to end of second claw,	$5\frac{1}{2}$

* We learn from the Naturalists' Library, that the animal *does not occur near Hudson's Bay,* and that the specimens received in Edinburgh were sent by Dr. Gairdner from the Columbia River.

"IRISH HARE, *Lepus Hibernicus*;"		*Inches.*
	length to end of tail,	24
	——— head,	5
	——— tail,	3½
	——— ears,	4
	from heel to end of claws,	5¾
"WHITE OR CHANGING HARE, *Alpine Hare*;"		
	length to end of tail,	23 !
	——— head,	4¾
	——— tail,	3½
	——— ears,	3½
	heel to end of claws,	5½

Our author next tells us of the difficulty he experienced in procuring specimens of the Marmot, and says, "*We* put *a ball* through *many*, but did not procure them. In fact the only way to be sure of getting a specimen is by sending a ball through the head. *My* friend Ramsay procured me two in this manner." The *italics* are our own, and serve to mark the authors English. As in speaking of his "friend Ramsay" he descends to the singular number, we are left to infer that, when he says "*we* put *a* ball through *many*,"—he must refer to *himself* and *his gun!* We are moreover scarcely prepared to admit the correctness of the phrase, "*a* ball through *many*," because it would seem to argue that *one* ball killed them *all*, whereas it is doubtless intended, that we should believe that *several* balls were expended!

These are blemishes in which no educated writer should indulge.

Of wild goats we are informed that the "*Thar*" was met with, to which, with his usual negligence, the writer applies the name of "*Capra Jemlaica*." The "*Thar*" is *not a goat*, but is the "*Antilope* (Nemorhœdus) *Thar*," of Hodgson, known to every sportsman of the western Himalayas by the names of "*Eimoo*" and "*Surrow*," while in Nepaul it is called "*Thar*." The "*Capra Jemlaica*," which Dr. Jameson met with, is the "*Capra Jharal*," vel "*Capra* (Hemitragus) *quadrimammis*," of Hodgson, known in the west as the "*Tehr*" and in Nepaul as the "*Jharal*." The curious fact of its possessing "four teats," is no new discovery of our author's, but was years ago

recorded by Mr. Hodgson, a notice of the novel circumstance having appeared from that gentleman's pen in the April number of the Journal of the Asiatic Society for 1836, nearly eleven years since! and had Dr. Jameson been less prone to rely upon his own imperfect knowledge, and more conversant with the labours and writings of his brother naturalists in India, he would have long since discovered in the pages of the same Journal, that the specific term of "*Quadri-mammis*" was founded on the fact of the animals having "four teats!" But thus it is in all his writings; each strange or novel fact in the Natural History of this country which gradually falls under his observation, is at once published to the world, without allusion to other writers who may have preceded him, in a manner which leads many to believe, that it is a new discovery,—something with which to astonish India, and raise his own name and reputation in the scientific world, while all the time these facts, although novel to himself, have been for years well known to every naturalist in the country!

The "*ibex*" to which Dr. Jameson alludes, but to which he applies no name, either local or scientific, was some four years since distinguished by Mr. Blyth, as "*Capra Sakeen.*"

Not one bit more fortunate or correct is our author in his remarks on the bears of the Himalayas;—he says, "one would infer, that the black bear or bhallow, is confined to Thibet, seeing that it is styled "Ursus Thibetanus," now it is not found in Thibet at all, *(so Mr. Hodgson stated many years ago!)* being confined to the southern side of the Himalayas. It occurs, however, every where from the base of the mountains to the snows, that is, from Rajpore in the Deyrah Doon and in the Doon itself, to Neetee, or from a height of 1,000 to 14,000 feet." Now it will scarcely be credited that, with the single exception of the non-occurrence of the black bear in Thibet, the above is one tissue of errors. We have for some years past been busily engaged in collecting information regarding these animals with a view to ascertain what species actually occur in the tracts here alluded to, and we are therefore enabled to speak positively to the fact of the existence of at least four distinct species, of all of which we have possessed living individuals.

The first of these is the "red bear of Kunawur" and "snow bear" of travellers, the "*Ursus Isabellinus*" of naturalists. It resides

in the snowy region of the Himalayas, and occurs on both sides of the range, although Dr. Jameson says not; our information on this point is, however, positive, and Mr. Hodgson has likewise stated the same fact, although, as he observes, it clings to the mountains and does not descend to the plains of Thibet. It is a large and powerful animal, feeding principally on roots, especially the wild rhubarb, which it digs up with great ease and rapidity; it has no idea of climbing, for which the straightness of its claws is ill adapted. It is by no means averse to flesh, less so by far than the Thibet bear, though all the Himalayan bears may be said to exist principally on vegetable substances; snakes, lizards, and even carrion are however never despised by them.

The other three, we shall now proceed to notice.

In the first place it is necessary to observe, in contradiction of Dr. Jameson's erroneous statement, that "the black bear or bhallow," *is not* the "*Ursus Thibetanus*;" in the second place it *is not* found above Rajpore; and in the third place, there are no less than three distinct species of "black bears" inhabiting the tracts between the Doon and the Snows. Of the existence of two out of these three, Dr. Jameson appears to be perfectly ignorant, and therefore, as in the instance of the wild sheep, he doubles them all up under one name. This is certainly the shortest, though not the most approved method of treating the Natural History of a country!

The "*Ursus Thibetanus*," or "*Reech*" of the hill tribes, occurs, properly speaking, only among the wooded tracts of the interior, from the snow downwards, but it seldom or never approaches the southern limit of its range, or outer hills, except during the intensity of winter, when the inclemency of the season above, drives it down to seek a more genial climate; it usually appears on the outer range during the months of November, December, and the early part of January, in order to feast upon the acorns, wild pears, and berries which are then abundant, (the animal being essentially a tree bear, climbing fearlessly and with the greatest ease) but after this period it again retires towards the interior. It is neither a resident at Rajpore, at the foot of the outer range, nor in the Doon, but is supplanted in those localities by a totally distinct and well known species, namely, "the black bear or bhallow," the "*Ursus labiatus*" or thick-

lipped bear of naturalists, and common to many other parts of India; this last species is never known to cross the outer range, though it mounts along the southern side of it to feed, retiring again to its base where it usually resides; it has been well described in this country by Captain Tickell, who also gives a figure of it in the Calcutta Journal of Natural History. It appears to be a far more shy and sullen animal than the Thibet bear, which last, if taken young and well treated, is usually very good tempered. Even if by the rigours of a severe winter the "*Ursus Thibetanus*" is ever forced to descend into the Doon, which we doubt, the elevation of its range would still be above that which Dr. Jameson has assigned to it, for the elevation of the Doon is given at 2,500 and Rajpore at 3,500 feet above the sea; how then the animal can range in those places "from 1,000 feet (the elevation of Saharanpore!) to 14,000 feet," is a problem which we shall leave to be solved by the sagacity of our author! But even allowing that the animal may sometimes descend to the Doon, its stay there is very short, and is occasioned by the inclemency of an unusually severe winter, a thing in fact which may possibly occur once in a dozen years, and as soon as the temperature above becomes milder by the return of fair weather, away goes bruin back to the higher hills; consequently its appearance in the Doon must be regarded as accidental and extraordinary, and can be allowed no weight in fixing the range of the species; we are however by no means prepared to admit, that this accidental occurrence in the Doon, ever does take place.

The third species of black bear is as yet scarcely determined to our satisfaction, although of its existence there can be no doubt; it appears to be most nearly related to the "*Ursus Malayanus*" or Malay bear, and inhabits the same regions as the Thibet bear, than which however it is much more rare; it occurs among the wooded mountains of the western Himalayas, and was some years ago noticed by Mr. Hodgson among the Mammalia of Nepaul. The animal is black, with a white chin and pectoral crescent, its chief peculiarity consisting apparently in the colour of the head, which from the muzzle to the roots of the ears is of a dull rusty-red. The natives call it the "Bowna Reach," and say it becomes larger than

" U. Thibetanus," and is of a solitary disposition, and from its shyness is less destructive to their crops than the Thibet bear.

In his ornithology, our author is somewhat more cautious, dealing chiefly in generic names ; still however, as to the " *Gallus Bankiva,*" the common jungle cock of sportsmen, being found at an elevation of 5,000 feet, we must say we entertain strong doubts on the subject. The bird is not uncommon in the Doon, and along the base of the hills about Rajpore, which latter place we should say is the greatest elevation at which it has ever been found on the western ranges, that is, about 3,500 feet. As however we find some species to the westward, confined to the Doon, which in Nepaul are said to occur on the hills, we do not deny the *possibility* of such likewise being the case in this instance.

In conclusion, while wishing Dr. Jameson every success in his future investigations, we would earnestly recommend the propriety of his looking somewhat oftener into the Indian Periodicals, wherein the labours of Indian Naturalists are recorded ;—let him remember, for he is prone to overlook the fact, that it by no means follows, that that which is novel to him, must necessarily be so to others ; and above all let him rest assured, that there are yet many things both in heaven and earth, that are alike unknown to the Edinburgh museum and to his own philosophy.

END OF VOLUME VII.

BISHOP'S COLLEGE PRESS.

POSTSCRIPT.

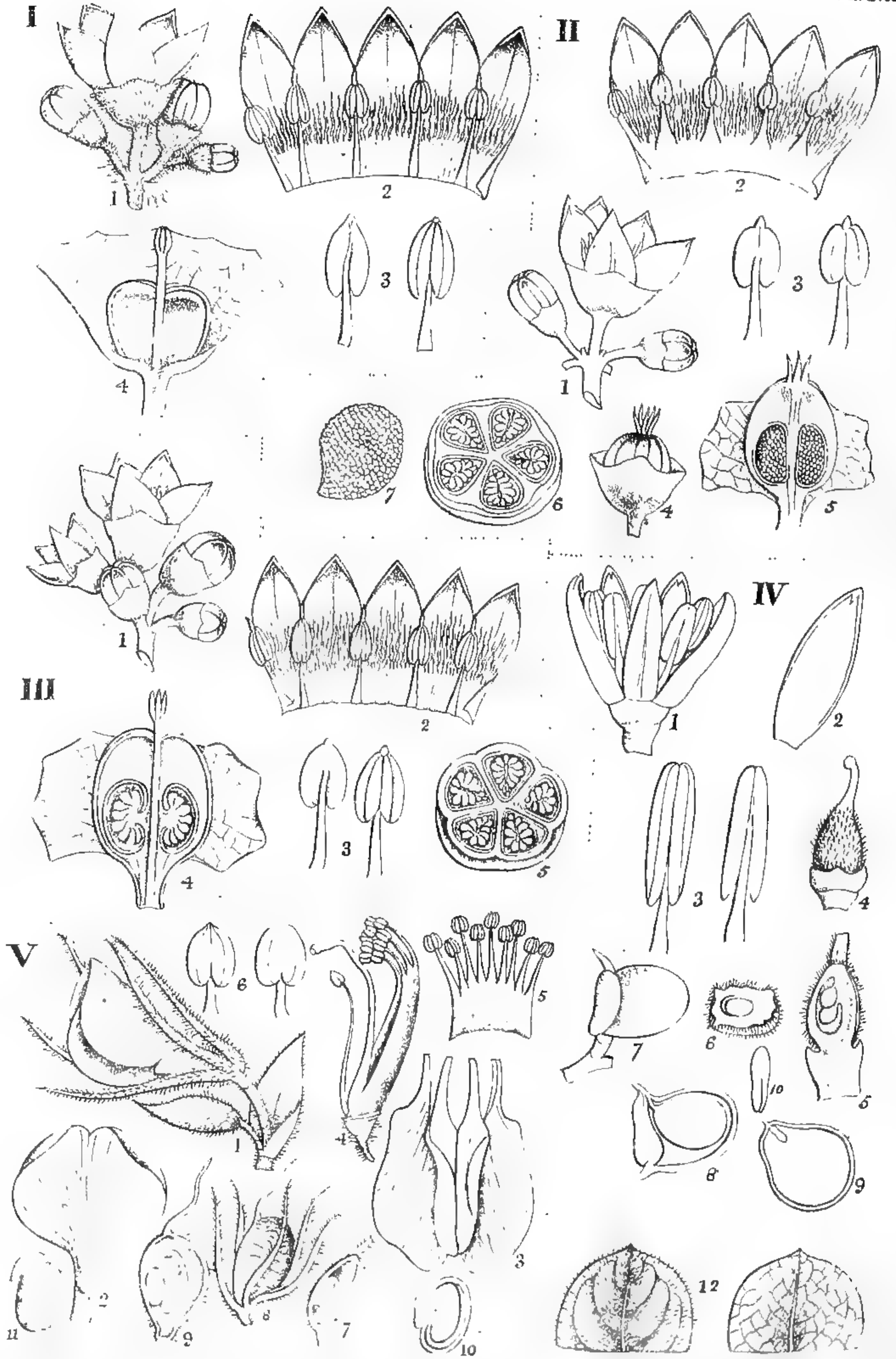
For the last month or two, newspapers and periodicals have been full of accounts of painless operations performed on individuals under the influence of the fumes of sulphuric ether. There is scarcely an hospital in Great Britain, in which its effects have not been tested; and in Calcutta, Madras, and Bombay, additional experiments have been made. There seems no reason to doubt that the discovery of the application of this hypnotic will form a most important era in surgery, as it differs from all other ones, in the facility with which it can be used, and in the certainty of its results. One might have expected, that occasional accidents, such as apoplexy from over-poisoning by the fumes, might have occurred, but such does not appear to be the case, and it would seem that we have few agents on the effects of which we can better depend. No dentist now ventures to operate without trying the effects of the ether, and it is certainly a grand thing to escape the horrors of tooth-drawing, even though we may not go the length of the boy, who wished to "have another tooth out for the fun of the thing."

The lateness in the arrival of our Foreign Journals, prevents our being able in this Number to allude to various matters of interest, which are at present attracting notice.

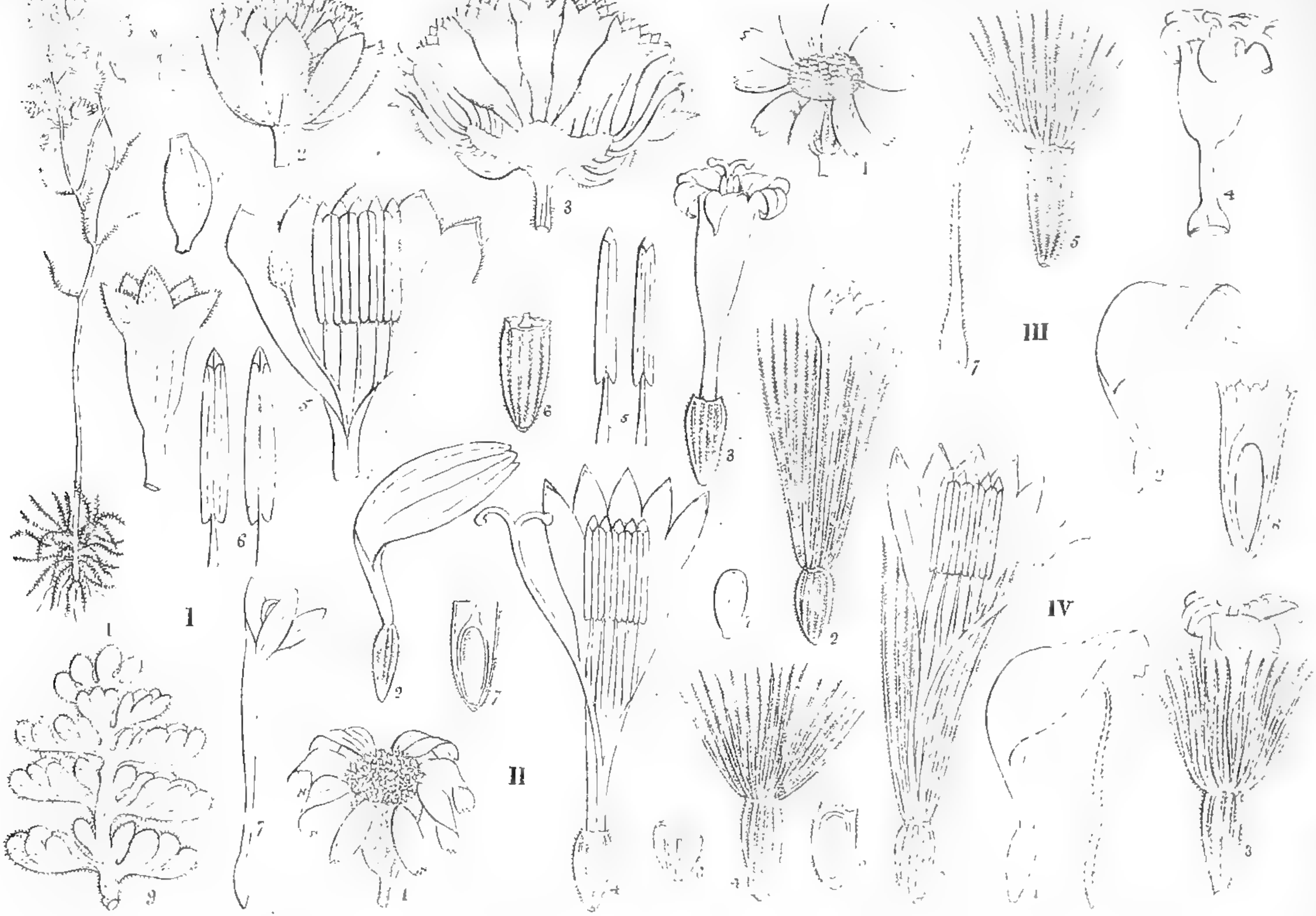
Thus, Professor Weber of Leipzic states, that he has discovered a rudimentary uterus, or rather the vestige of an uterus, in man, and in the male of the horse, pig, dog, cat, rabbit, and beaver; and we observe that M. Blandet has been reproducing sounds from the larynx of corpses by dexterous manipulation, which has led him to infer, that only one of the chordæ vocales is essential to voice, just as only one eye is required for vision. Liebig too, who has been carrying on an angry controversy with Mulder, now states as the result of his experiments, that *proteine* has no existence.

March 16*th*, 1847.

Anemia Wightiana, Gardn



I Axanthes longifolia, II Axanthes Ceylanica, III Axanthes elliptica, IV Apodytes Benthamiana, V Nicoldonia congesta,



I Cyathocline lutea, II Madacarpus Belgaumensis. III Doronicum [illegible], IV Doronicum [illegible],

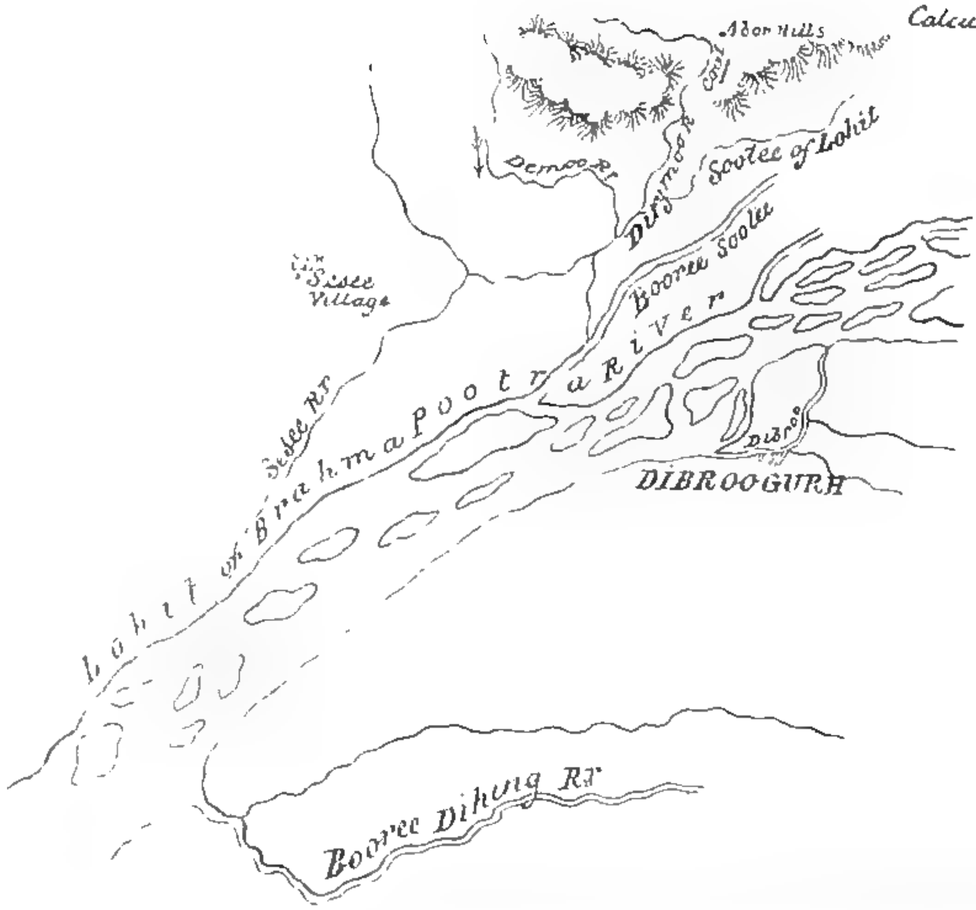



fig. 1

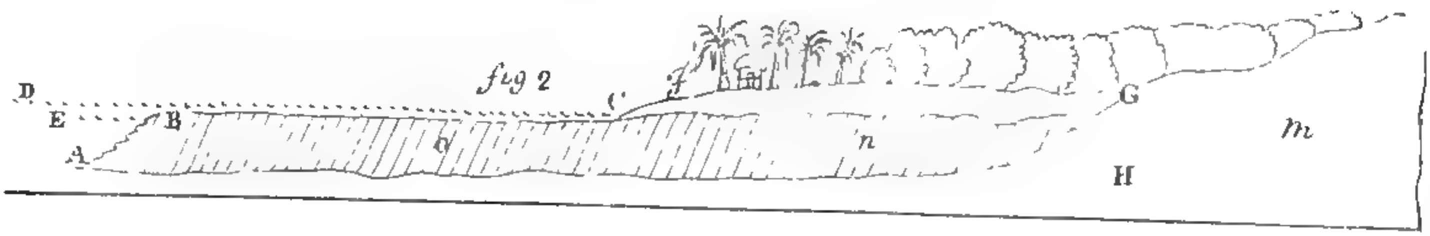


fig. 2

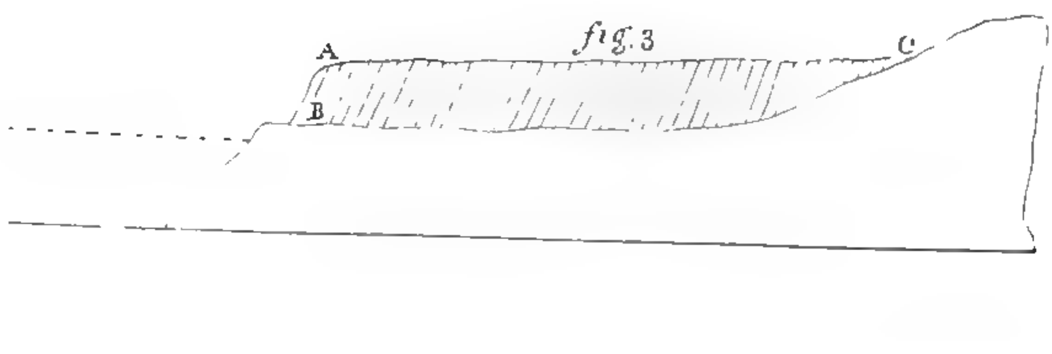
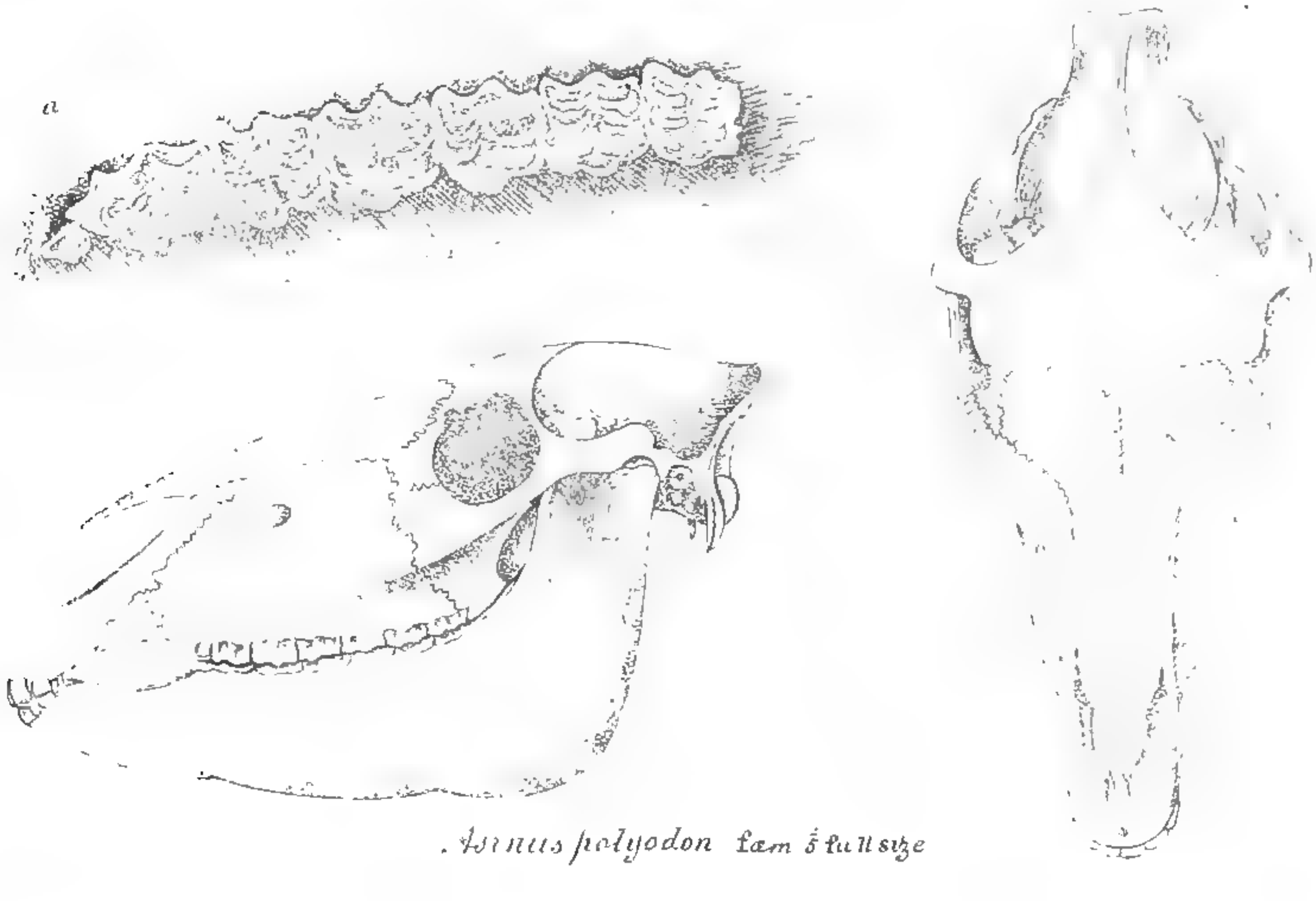
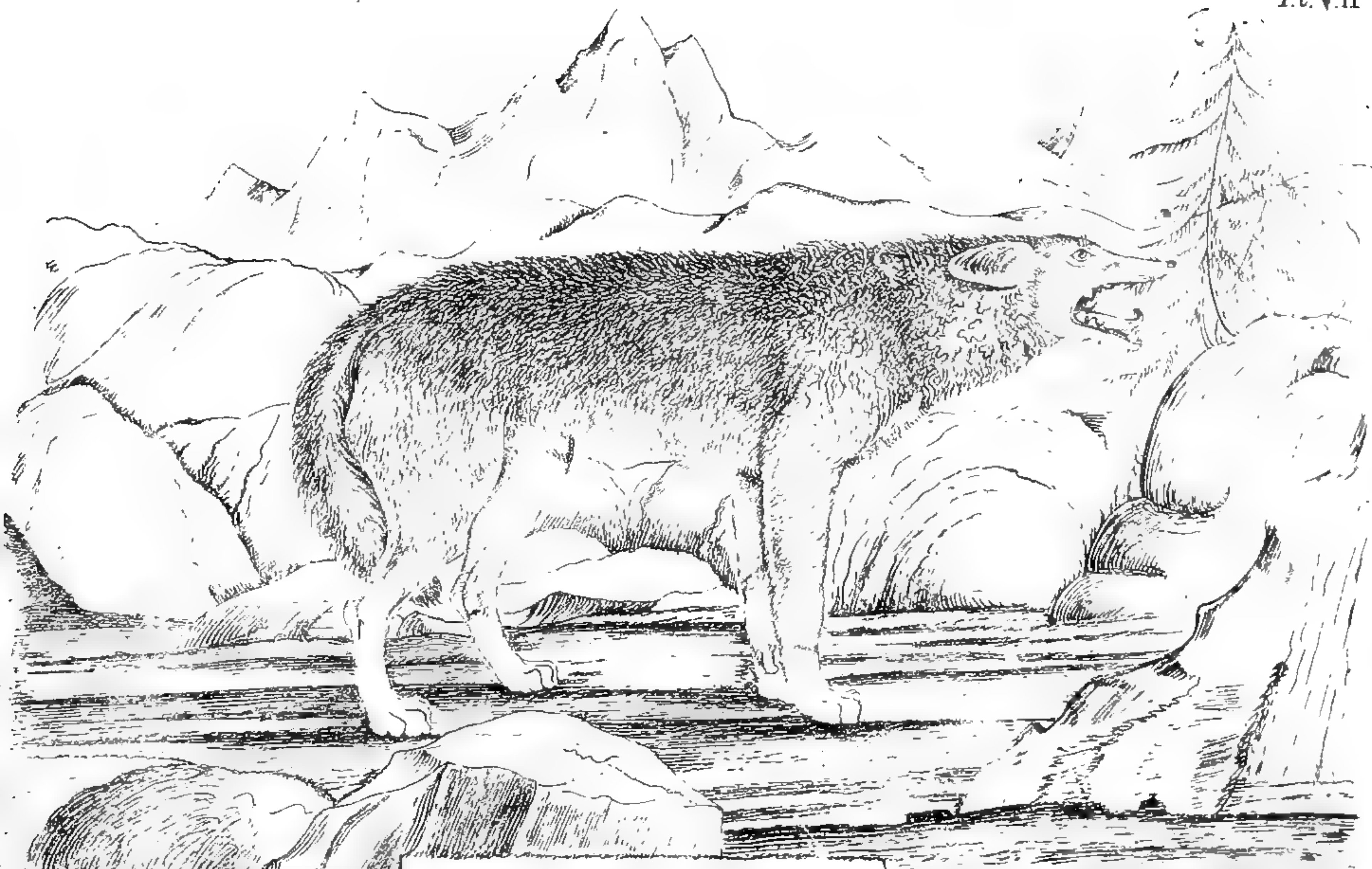


fig. 3

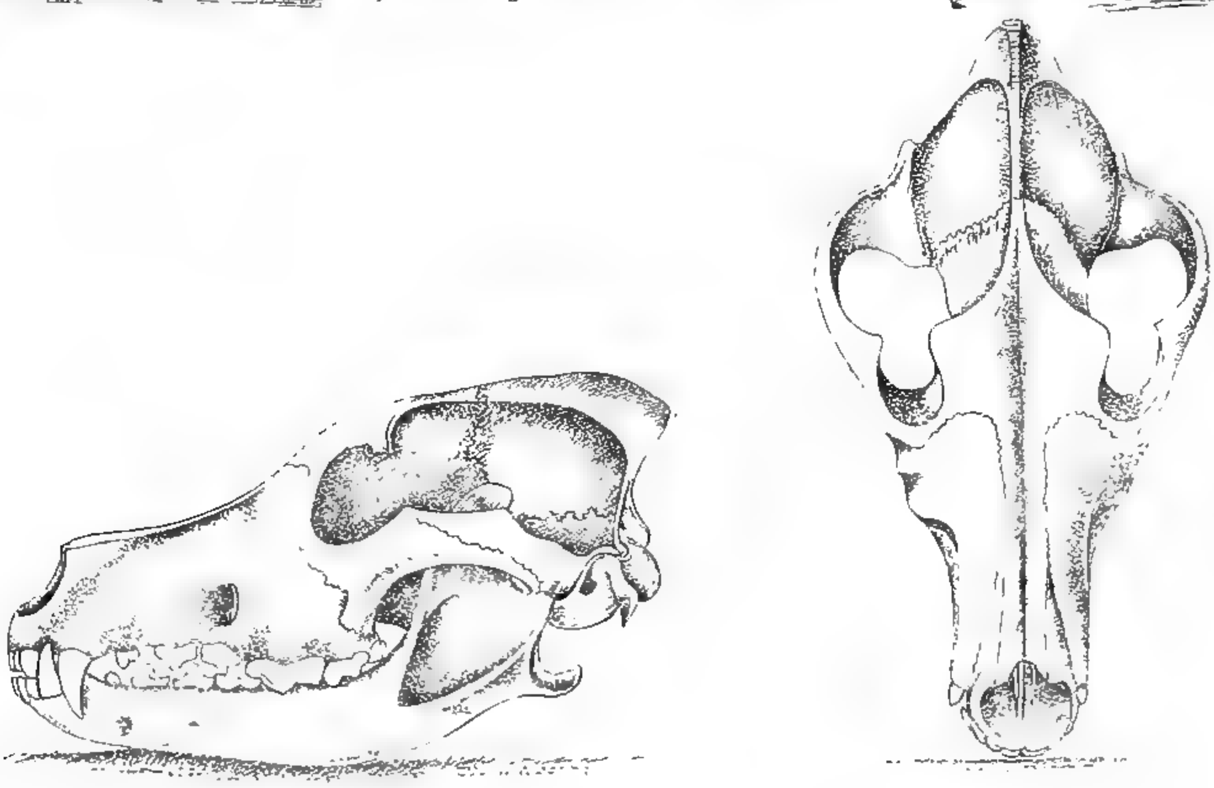
Asinus polyodon mihi The Kiang of East Tibet



Asinus polyodon fæm ⅕ full size



Lupus laniger mihi. The chanu of East Tibet



Lupus laniger mihi fam. Tibet

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